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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1987.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

RESISTIVITY OF VERY PURE WATER AND ITS MAXIMUM VALUE,
Foxboro Analytical, Burlington, MA.
T. S. Light, and P. B. Sawyer.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 175-184, 2 fig, 6 tab, 11 ref.

Descriptors: *Resistivity, *Water analysis, *Water quality, Hydrogen ion concentration, Water temperature, Conductivity.

Theoretical calculations have been made for the resistivity (and its reciprocal, the conductivity) of pure water in the vicinity of the neutral point at 25 C. A surprising result is that the maximum resistivity is not found at pH 6.998, which corresponds to absolute water, but at pH 7.039, which corresponds to water with approximately 0.8 micrograms/L, (parts per billion) of sodium hydroxide added. The resistivities corresponding to these two points are 18.18 and 18.28 M omega.cm respectively. Although the effect is slight, it will be of interest to users of high-purity water since resistivity is widely used as a criterion for water purity. The temperature coefficient of resistivity is also evaluated. (See also W87-07279) (Author's abstract)
W87-07296

1B. Aqueous Solutions and Suspensions

ION-ASSOCIATION MODEL FOR HIGHLY SALINE, SODIUM CHLORIDE-DOMINATED WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2K.
W87-06728

2. WATER CYCLE

RAINFALL EROSIVITY IN IRAQ,
Salahaddin Univ., Arbil (Iraq). Dept. of Soil Science.
For primary bibliographic entry see Field 2J.
W87-07563

2A. General

RUNOFF PREDICTION USING REMOTE SENSING IMAGERY,
Draper Engineering Research, Atlanta, GA.
S. E. Draper, and S. G. Rao.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 941-949, December 1986. 3 fig, 5 tab, 21 ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Remote sensing, *Urban runoff, *Urban hydrology, *Runoff, *Computers, Imperviousness, Watersheds, Estimating, Prediction, Cost analysis, Statistics.

Percent imperviousness is an important parameter in modeling the urban rainfall-runoff process and is usually determined using manual methods such as random sampling or conventional accounting methods. Two computerized methods were used for estimating the percent imperviousness of urban watersheds using high altitude remote sensing imagery. These methods include the Laser Image Processing Scanner and the Video-Tape Camera system. Imperviousness is directly estimated in the using the Laser Image technique while with the Video-Tape Camera it is estimated as a function of the statistics of the responses on emulsions of the imagery. The percent imperviousness computed by utilizing remote sensing imagery was used with the conceptual models of rainfall-runoff models. The models were applied to four urban watersheds and the runoff prediction results indicate that imperviousness determined by using remote sensing imagery was as accurate as that obtained by the manual methods, and that the use of remote sensing imagery requires significantly less time and money. (Author's abstract)
W87-06687

SPACE-TIME MODELING OF VECTOR HYDROLOGIC SEQUENCES,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
For primary bibliographic entry see Field 2E.
W87-06689

SEMI-DISTRIBUTED ADAPTIVE MODEL FOR REAL-TIME FLOOD FORECASTING,
Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.
For primary bibliographic entry see Field 2E.
W87-06695

MARKOV-WEIBULL MODEL OF MONTHLY STREAMFLOW,
Hartford Univ., West Hartford, CT. Dept. of Civil Engineering.
R. J. Dalphin.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 53-69, January 1987. 6 fig, 8 tab, 40 ref.

Descriptors: *Model studies, *Streamflow, *Stream discharge, *Simulation analysis, *Markov process, Drought, Flow, Distribution, Statistics, Reservoirs.

A conceptually simple, month-to-month lag-1 Markov streamflow simulation model was developed and extensively tested. Streamflow in any month was represented probabilistically by a family of three-parameter Weibull distributions conditioned on flow in the preceding month. The marginal distributions of the monthly and annual series of the simulated and historical data compare well statistically, and goodness-of-fit was excellent. Month-to-month correlation coefficients, auto-correlation coefficients of the annual series, and the Hurst coefficient of the simulated and historical data compared well, as did comparative statistics of various drought-high flow characteristics and flows of both sets of data through several hypothetical reservoir systems. (Author's abstract)
W87-06710

SYNTHETIC UNIT HYDROGRAPH,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
W. P. James, P. W. Winsor, and J. R. Williams.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 70-81, January 1987. 4 fig, 5 tab, 6 ref.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Model studies, *Hydrographs, *Unit hydrographs, Hydrologic models, Equations, Estimating, Prediction, Catchment areas, Watersheds, Slopes.

The unit hydrograph is a valuable tool used to predict runoff due to a rainfall event. The unit hydrograph of a drainage basin is the runoff hydrograph resulting from one unit of rainfall excess generated uniformly over the basin area at a uniform rate during a specified period of time. The shape of the unit hydrograph reflects the runoff characteristics of the drainage system. Equations for computing the unit hydrograph for ungaged watersheds are developed. The two-parameter gamma function unit hydrograph from the HYMO hydrologic model is used and equations for estimating the time to peak and the recession constant are developed. The equations use physical characteristics of the drainage basin to predict the parameters for the unit hydrograph. Stepwise regression analysis is used to reduce the number of physical and hydrological variables to 4, which are basin area, height, length, and watershed slope. Records of 283 storm events from 85 watersheds in 13 states were studied to develop and verify the equations. Results of the study indicate that these equations can be used to more accurately estimate the runoff hydrograph than the Soil Conservation Service dimensionless unit hydrograph procedure for mild and steep watershed slopes. (Authors' abstract)
W87-06711

METHOD OF STREAMFLOW DROUGHT ANALYSIS,
Novi Sad Univ. (Yugoslavia). Inst. of Water Resources.
For primary bibliographic entry see Field 2E.
W87-06826

INPUT DETECTION BY THE DISCRETE LINEAR CASCADE MODEL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2E.
W87-07070

RECURSIVE STATE AND PARAMETER ESTIMATION WITH APPLICATIONS IN WATER RESOURCES,
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
W. Schilling, and J. Martens.
Applied Mathematical Modelling AMMODL, Vol. 10, No. 6, p 433-437, December 1986. 2 fig, 1 tab, 7 ref. German Research Association (DFG) grants Le 229/19 and Si 242/5.

Descriptors: *Mathematical models, *Error analysis, *Algorithms, *Multivariate analysis, *Planning, Computers, Weather forecasting, Dissolved oxygen, Peak demand.

Hydrologic models, as well as measurements of hydrologic processes, are corrupted by noise. The Kalman filter is a convenient tool for estimating the true but unknown state of a hydrologic system. It is, however, difficult to specify the necessary error covariances. A procedure is proposed to estimate the error covariances recursively in a combined state and parameter filter. Applications of the procedure yield meaningful results for two hydrologic data series of very different character. A major benefit of the proposed algorithm seems to be its robustness against instability. (Author's abstract)
W87-07145

STABLE ISOTOPE COMPOSITIONS OF FOSSIL MOLLUSKS FROM SOUTHERN CALIFORNIA: EVIDENCE FOR A COOL LAST INTERGLACIAL OCEAN,
Geological Survey, Denver, CO.
D. R. Muhs, and T. K. Kyser.
Geology GLGYB, Vol. 15, No. 2, p 119-122, February 1987. 1 fig, 1 tab, 50 ref.

Descriptors: *Oceans, *Paleoclimatology, *Oxygen isotopes, *Model studies, *Isotope studies, Mollusks, Temperature, Ocean circulation, Marine climates.

Stable isotope conditions were determined for modern mollusks and fossil mollusks collected from uplifted marine terraces at three localities in southern California. By using a paleoclimatic model that decouples the temperature and ice-volume signals in ocean water, ocean water temperatures off southern California are estimated to have been -3.8 C at about 85 ka, -3.0 C at about 107 ka, and -2.2 C at about 125 ka relative to present temperature. These results indicate rather cool conditions during the peak of the last interglacial stage at 125 ka and conflict with results from terrace faunal studies that suggest water temperatures were as warm as or warmer than at present. (Author's abstract)
W87-07161

CLIMATIC VARIATION AND SURFACE WATER RESOURCES IN THE GREAT BASIN REGION,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
For primary bibliographic entry see Field 2E.
W87-07180

APPLICATION OF RORB MODEL TO A CATCHMENT IN SINGAPORE,
National Univ. of Singapore. Dept. of Civil Engineering.
S. Selvalingam, S. Y. Liong, and P. C. Manoharan.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 81-90, February 1987. 4 fig, 8 tab, 20 ref. National Univ. of Singapore Grant RP 98/83.

Descriptors: *Rainfall-runoff relationships, *RORB, *Runoff routing, *Model studies, *Routing, *Catchment areas, Simulation, Hydrographs, Singapore, Watersheds, Performance evaluation, Rainfall, Calibrations, Storms.

Runoff Routing model (RORB) is a general model applicable to both rural and urban catchments. The performance of the model is illustrated through its simulation of flood runoff hydrographs in an urban catchment in Singapore. The essential feature of the model is the routing of rainfall excesses on subareas through some arrangement of concentrated storage elements, which represent the distribution of temporary storage of flood runoff on the watershed. This nonlinear routing procedure of the storage elements has two common parameters, k sub c and m. With the limited data available, these two parameter values were determined through calibration runs. The same set of values of k sub c and m were then used in the model to determine the runoff hydrographs of five other storms selected from the rainfall events between 1979 and 1981. It was found that the simulated runoff hydrographs matched reasonably well with the recorded hydrographs. (Author's abstract)
W87-07183

REGIONAL APPLICATION OF AN APPROXIMATE STREAMFLOW PARTITIONING METHOD,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W87-07185

EVOLUTION IN COMPUTER PROGRAMS CAUSES EVOLUTION IN TRAINING NEEDS: THE HYDROLOGIC ENGINEERING CENTER EXPERIENCES,
Hydrologic Engineering Center, Davis, CA.
V. R. Bonner.
Available from the National Technical Information Service, Springfield, Virginia. 22161, as AD-A145 601, Price codes: A03 in paper copy, A01 in microfiche. Technical Paper No. 98, July 1984. 20 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Hydrologic models, *Computers, *Training, Hydrologic data, Computer programs.

Since the Hydrologic Engineering Center (HEC) was established in 1964, it has provided training in hydrologic engineering for the Corps of Engineers. The Center has also been responsible for 'computerizing' hydrologic methods and making those programs available to the Corps as well as the general public. These computerized procedures and the required information for project investigations have grown to the point that the program user requires an understanding of a multitude of technical fields. The development of comprehensive computer programs provides an opportunity to bring together previously fragmented technical studies into one integrated study. Several examples of the coordinated program packages and their impact on the evolving training program of the HEC are presented to illustrate the developing technology and its impact on the training and education needs of engineers in the Corps. (Author's abstract)
W87-07303

CARIBBEAN ISLANDS REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-07330

HYDROLOGICAL FORECASTING.
John Wiley and Sons, New York, New York, 1985. 604 p. Edited by M.G. Anderson and T.P. Burt.

Descriptors: *Hydrologic data, *Forecasting, *Model studies, *Hydrologic models, Slopes, Radar, Remote sensing, Precipitation, Rainfall-runoff relationships, Water quality, Arid-zone hydrology.

The growth in recent years of hydrological forecasting techniques, both 'hardware' and 'software' in character, has been quite outstanding. The primary objective of this book is to outline at the postgraduate level the current state of forecasting capability in the major hydrological areas relevant to the watershed, as opposed to the hillslope, scale. Chapters include: modelling strategies, hillslope hydrology, use of radar for precipitation measurements, runoff generation in arid and semi-arid zones, and water quality. (See also W87-07347 thru W87-07362) (Lantz-PTT)
W87-07346

MODELLING STRATEGIES,
Bristol Univ. (England). Dept. of Geography.
M. G. Anderson, and T. P. Burt.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 1-13, 2 fig, 1 tab, 22 ref.

Descriptors: *Unit hydrographs, *Runoff models, *Model studies, *Hydrologic models, *Stream flow forecasting, *Rainfall-runoff relationships, Hydrology, Computer models, Limiting factors, Calibrations.

The concept of the unit hydrograph, a methodology which was to dominate hydrology for a quarter of a century, is still in widespread use today. More recently, the advent of high-speed computers has led to a proliferation of runoff models which achieve generalization of reality using a variety of mathematical approaches. All models seek to simplify the complexity of the real world by selectively exaggerating the fundamental aspects of a system at the expense of incidental detail. In presenting an approximate view of reality, a model must remain simple enough to understand and use, yet complex enough to be representative of the system being studied. The limitations of models fall into five main categories: (1) limitations due to inadequacies of current theory structure or to failure of the model to incorporate certain elements of current theory: such restrictions include the computational difficulties associated with solution of deterministic flow equations, and the inability to incorporate variable source area concepts into catchment runoff models; (2) limitations caused by the scarcity of appropriate field data for model calibration and operation. The accuracy of field data, both with respect to sample size and measurement, may limit the effectiveness of model predictions, regardless of the modeling structure itself; (3) limitations caused by the adequacy of computer capacity. Apart from the large deterministic or distributed models, many lumped conceptual models are quite suitable for use on microcomputers; (4) limitations of calibration procedures. A number of problems arise in this respect, including interrelated parameters, the lack of standardized error functions, and the need for more sophisticated sensitivity analyses in any model evaluation. Insufficient attention to model calibration can lead to major problems, particularly where the range of the calibration data is exceeded or where field measurements introduce unforeseen errors into the analysis; and (5) limitations in selected management applications where operational constraints have not been fully incorporated into hydrological simulation models. (See also W87-07346) (Lantz-PTT)
W87-07347

SOIL WATER MODELLING,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 2G.
W87-07348

HILLSLOPE HYDROLOGY,
Leeds Univ. (England). Dept. of Physical Geography.
M. J. Kirkby.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 37-75, 21 fig, 1 tab, 42 ref.

Descriptors: *Hydrographs, *Rainfall-runoff relationhips, *Slopes, *Hydrologic studies, *Model studies, *Hydrologic models, *Infiltration, Surface flow, Groundwater movement, Flow profiles.

Models and concepts for forecasting hillslope hydrographs are presented at a range of scales and levels of detail. In constructing or selecting an appropriate procedure, the level of detail should be related to the purpose of the forecasting. Where the primary interest is in forecasts and interpretations at the hillslope or soil scale, then the most detailed simulations are appropriate, in that they make the least simplifications of the physical processes of water movement, and can accept highly detailed data on soil and topographic differences. Where the primary interest is in forecasting flows from whole catchments of more than 1 sq km, then both the cost of providing very detailed data and the computation involved argue for a highly simplified view of the hillslope. Hillslope flow may be dominated by any one of several processes. Horton overland flow, saturation overland flow and saturated throughflow are the main possibilities which come within the scope of hillslope hydrology. Several early models attempted to estimate contributing areas directly. More recent hillslope models have attempted to achieve greater physical reality. One important growth area has been in routing overland flow over simplified catchments, incorporating some form of infiltration function. Kinematic wave solutions have been obtained for the overland flow, usually relying on Manning's equation to obtain the wave velocity - depth relationship. (See also W87-07346) (Lantz-PTT)
W87-07349

MODELLING CHANGES IN FOREST EVAPOTRANSPIRATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2D.
W87-07352

RUNOFF GENERATION IN ARID AND SEMI-ARID ZONES,
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
A. Yair, and H. Lavee.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 183-220, 23 fig, 3 tab, 78 ref.

Descriptors: *Runoff, *Arid zone, *Semi-arid zone, *Model studies, *Hydrologic models, *Rainfall-runoff relationships, Streamflow, Runoff rates, Probabilistic process, Stochastic process, Overland flow, Forecasting.

Throughout the world the need for hydrological studies results from engineering problems encountered by man, such as flooding, design of bridges and dams, or soil erosion. Most studies focused on stream flow. Data obtained were processed in three different ways: (1) the probabilistic approach; (2) the deterministic approach; and (3) the stochastic approach. Due to the paucity of data, most of the recent hydrological models developed for arid and semi-arid areas are of the probabilistic or stochastic types. However, the lack of adequate data and the extreme variability in space and time of all factors which control the runoff process in arid and semi-arid areas cause the validity of such models to be highly questionable. A thorough understanding of the factors which control the runoff

process is needed, which can only be gained by systematically analyzing all of the various factors involved. The systematic study of spatial and temporal variations in overland flow should therefore be of prime interest to any scientist or engineer interested in preparing a model of hydrological forecasting in arid and semi-arid areas. This study has two main objectives: (1) to analyze the most important factors controlling runoff generation processes in semi-arid areas. The deterministic approach is used, and special attention is paid to the spatial variability of these factors over short distances and the effect of this variability on hydrological forecasting; and (2) to present a simulation model of overland flow generation on an arid limestone hillside. The model is tested against a record of natural flow events. (See also W87-07346) (Lantz-PTT)
W87-07354

LUMPED CATCHMENT MODELS,
Institute of Hydrology, Wallingford (England).
J. R. Blackie, and C. W. O. Eeles.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 311-345, 6 fig, 1 tab, 38 ref.

Descriptors: *Rainfall-runoff relationships, *Catchment areas, *Hydrologic models, *Lumped models, *Model studies, Spatial distribution, Hydrologic properties, Precipitation, Vegetation, Soil properties.

To model the complete catchment hydrological system accurately would call for a very detailed knowledge of the catchment, of the physical and biological processes governing water movement and of the way that these interact. In practice this is not feasible. Simplifications have to be made. These can be either in the representation of the physical structure or in the representation of the process involved. The choice of what to simplify and to what extent is dictated by a wide range of considerations. The most common simplification made in catchment modelling is lumping or spatial averaging. The implication is that the catchment system, its inputs and response can be represented mathematically using only the dimensions of depth and time. In such a system no account is taken of variations within the catchment of precipitation, vegetation, soils, geology or topography. For the purposes of the model a 10 mm precipitation input is a 10 mm input regardless of whether it is 10 mm uniformly distributed or a 30 mm storm occurring over one-third of the catchment only. This is the extreme case of the spatial averaging that is present to some degree in all catchment models - even the most complex distributed models - and its ultimate justification is the degree of success achieved. The lumped model concept tends to be considered as adequate only for small catchments with homogeneous vegetation, soils and geology, but practical experience has shown it to be applicable to a wider range of catchment sizes with mixed vegetation cover, geology and soils. Highly asymmetric patterns of rainfall can be tolerated also, provided that these patterns are reasonably stable. The key factor in the successful application of lumped models is stability of the catchment system, stable spatial distributions of precipitation, of vegetation type and cover and of soil characteristics. This and other factors determining the range of uses of lumped models are discussed in this chapter. (See also W87-07346) (Lantz-PTT)
W87-07357

VARIABLE SOURCE AREA MODELS,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
C. A. Troendle.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 347-403, 29 fig, 4 tab, 67 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Hydrologic properties, *Hydrologic models, *Computer models, *Management planning, *Simulation analysis, Flow profiles, VSAS1, VSAS2, Performance evaluation, Mathematical studies, Mathematical models, Economic aspects.

The science of hydrology has developed to the point where what may have been called the traditional or 'classical' concepts for processes are no longer accepted as the norm for studying sources, pathways, and turnover rates of water in forested or well-vegetated environments. What is discussed in this chapter is the nature of the flow-generating processes from forest and wildland, and the degree to which this dynamic and variable response can be modeled. Two simulation programs were developed and tested: VSAS2 (Variable Source Area Simulation 2) represents a significant improvement over VSAS1 (Variable Source Area Simulation 1). Errors in conservation of mass in estimating segment area during redissection have been eliminated. The same applies to any errors in conservation of mass in the soil moisture storage routines associated with the redissection routines. Technical improvements have also been made in the soil water routing routines. VSAS2 is still a prototype: improvements still need to be made. The primary change may be the inclusion of an implicit solution to the flow equations and a second may be to improve the spatial resolution in defining segments. Both changes would increase simulation time and computer storage requirements. Stability and accuracy in the solution of the flow equations could be greatly enhanced, and a truly variable iteration time step could be used if an implicit solution to the flow equations were utilized. The latter would be useful in balancing the trade-off between temporal resolution and simulation cost. (See also W87-07346) (Lantz-PTT)
W87-07358

DISTRIBUTED MODELS,
Institute of Hydrology, Wallingford (England).
K. Beven.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 405-435, 9 fig, 2 tab, 57 ref.

Descriptors: *Groundwater movement, *Streamflow, *Model studies, *Rainfall-runoff relationships, *Surface-groundwater relations, *Hydrologic models, *Hydrologic properties, *Distributed models, Catchment areas, Spatial distribution, Mathematical equations, Mathematical models, Flow patterns, Darcy's Law, Manning's Law.

In this chapter, distributed models are taken to mean models of catchment hydrology that are physically based. Physically based models are necessarily distributed because the equations on which they are defined generally involve one or more space coordinates. They thus have the capability of forecasting the spatial pattern of hydrological conditions within a catchment as well as simple outflows and bulk storage volumes. The descriptive equations for physically based models are in general nonlinear partial differential equations that cannot be solved analytically for cases of practical interest. Solutions must then be found using approximate numerical methods. A wide variety of methods is available, all of which involve some form of discretization of the space coordinates, and also for transient models, of the time ordinate. Solutions are then found for the points or nodes defined by the space-time discretization. For some hydrological processes the equation of flow through the system are not well understood and resort must then be made to empirical generalizations that are not explicitly distributed. Indeed, the complexities of hydrological systems are such that all the model components ultimately rely on empirical relationships; such as Darcy's law for flow through a porous medium, or Manning's law for channel flows. A further characteristic of distributed models is that they are expensive to run. However they forecast what happens at a large number of points within a catchment, and do not merely deal with the conceptual averages of the 'lumped' models. Since distributed models also directly incorporate the non-linearities of the descriptive equations, short time steps may be necessary at times of rapid change to maintain a stable solution. The development of distributed modelling of catchment hydrology has been a slow faltering process. There have been numerous papers on modelling individual processes, especially groundwater flows, unsaturated soil water flow and channel routing, but there is a much smaller literature on models involving interacting processes and the application of catchment scale models to real-world problems. However a number of such models are now reaching the testing stage. (See also W87-07346) (Lantz-PTT)
W87-07359

CHANNEL ROUTING,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 2E.
W87-07360

REAL-TIME FORECASTING,
Princeton Univ., NJ. Dept. of Civil Engineering.
E. F. Wood, and P. E. O'Connell.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 505-538, 13 fig, 16 tab, 41 ref. NSF Grant No. ENG-77-11841.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Streamflow forecasting, *Hydrologic models, *Forecasting, Hydrologic properties, Mathematical models, Mathematical studies, Algorithms, Data evaluation.

This chapter focuses on real-time hydrological forecasting, and the mathematical apparatus necessary to carry out such forecasting. To successfully design real-time forecasting models, one requires an in-depth understanding of both hydrology and statistics. This chapter emphasizes the statistical and systems theory aspects of forecasting. There are three aspects which are crucial to successful forecasting: (1) the importance of representing the hydrological model within the feedback structure of a state vector model. This structure will allow the model to incorporate data in real time as they are received. The representation of the hydrological dynamics within the state vector framework also permits the utilization of all the results in systems theory pertaining to such systems; (2) the importance of data collection to model and parameter identification. All models, including physically based models, are empirical in that either the model structure or the parameter values, or both, are derived from data. As it was shown, strict requirements must be met if the model and its parameters can be identified from the data. If the identifiability conditions are not met, then model performance will be extremely poor with the forecasts having little value; and (3) useful algorithms for estimating the parameters from noisy data. A variety of procedures are presented, the base approach depends upon the application. In closing, it is important to stress that there is no 'best' model for hydrological forecasting. Different types of models are required to fulfill different roles and objectives. In an actual problem-solving context the 'best' model will evolve from an interplay of both internally descriptive and black-box models, where comparisons of the forecasting performance of various models is evaluated on the problem-specific data. (See also W87-07346) (Lantz-PTT)
W87-07361

MANAGEMENT FORECASTING REQUIREMENTS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 4A.
W87-07362

INFLUENCE OF ANTECEDENT CATCHMENT CONDITIONS ON SEASONAL FLOOD RISK,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07477

INTERPOLATION OF BINARY SERIES BASED ON DISCRETE-TIME MARKOV CHAIN MODELS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-07482

Group 2A—General

USE OF CONTRASTING D/H RATIOS OF SNOWS AND GROUNDWATERS OF EASTERN NEW YORK STATE IN WATERSHED EVALUATION,
Houston Univ., TX. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2E.
W87-07483

LAGRANGIAN MODEL OF NITROGEN KINETICS IN THE CHATTAHOOCHEE RIVER,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W87-07491

METHOD FOR COUPLING A PARAMETERIZATION OF THE PLANETARY BOUNDARY LAYER WITH A HYDROLOGIC MODEL,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-07512

2B. Precipitation

DETACHMENT AND SPLASH OF A COHESIVE SOIL BY RAINFALL,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W87-06654

INSECTICIDE WASHOFF FROM COTTON PLANTS AS A FUNCTION OF TIME BETWEEN APPLICATION AND RAINFALL,
Agricultural Research Service, Oxford, MS.
For primary bibliographic entry see Field 5B.
W87-06657

RAINOUT LIFETIMES OF HIGHLY SOLUBLE AEROSOLS AND GASES AS INFERRED FROM SIMULATIONS WITH A GENERAL CIRCULATION MODEL,
National Center for Atmospheric Research, Boulder, CO.
F. Giorgi, and W. L. Chameides.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 13, p 14367-14376, December 1986. 2 fig, 2 tab, 55 ref. NASA Grant NAG-1-3-85 and NSF Grant ATM-8208828.

Descriptors: *Precipitation, *Rain, *Simulated rainfall, *Aerosols, *Acid rain, *Path of pollutants, *Model studies, Chemistry of precipitation, Atmosphere, Rain-out, Particulate matter, Gasses, Circulation, Tracers.

Rainout of particulate and gaseous soluble atmospheric compounds is the result of the incorporation of the species into cloud droplets and subsequent removal of these droplets from the atmosphere in rainwater. This is a very complex process that depends upon the interaction of a chemical species with the microscopic and macroscopic features of the atmospheric hydrologic cycle. The rain-out determined lifetimes of highly soluble particulate and gaseous atmospheric compounds are investigated using general circulation model simulations in which removal is explicitly calculated in terms of the local, model-produced precipitation rates. The calculations indicate that because of the episodic and asymmetric nature of rainout, species' lifetimes depend not only on the amount of precipitation but also on the characteristics of the precipitation regime (such as duration and frequency of the precipitation events) and on the direction of the tracer main flow (determined by the species' average mixing ratio gradient). For this reason, averaged rainout lifetimes flowing downward from the stratosphere are found to differ substantially from those of tracers of surface origin flowing upward or tracers of a more ubiquitous tropospheric source. These results imply that the use of a first-order parameterization to simulate rainout in a photochemical model that does not explicitly calculate precipitation can be inadequate in representing this process. A computationally efficient parameterization that includes the effects of intermittence and asymmetry of rainout is proposed, and it is shown how this parameterization can be used to estimate rainout-determined tropospheric residence times from observational data sets. A review of published estimates of submicron aerosol tropospheric residence times based on observations shows that these are consistent with our model results. (Authors' abstract)
W87-06697

LAGRANGIAN TIME SCALES CONNECTED WITH CLOUDS AND PRECIPITATION,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
M. Hamrud, and H. Rodhe.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 13, p 14377-14383, December 1986. 5 fig, 2 tab, 18 ref. National Swedish Environment Protection Board Contract 5315133-87.

Descriptors: *Air pollution, *Acid rain, *Path of pollutants, *Clouds, *Precipitation, Lagrangian time scales, Atmosphere, Particulate matter, Gasses, Estimating, Winds, Humidity, Weather data collections, Seasonal variation.

The behavior of chemical compounds in the atmosphere is governed by both chemical and physical processes. For particles and water-soluble gases, one important process is the incorporation of compounds into clouds. Clouds may act as either a source or a sink for chemical compounds. An attempt is made to estimate Lagrangian time scales connected with clouds in the atmosphere. Three dimensional wind and relative humidity obtained from the First GARP Global Experiment data set are used to compute 3-dimensional trajectories with accompanying clouds. From the meteorological history of the trajectories, estimates are made of the average time from the release of a trajectory until the first cloud passage and the average time between first and second cloud passage. Geographical and seasonal variations of these parameters are calculated and discussed. Since the clouds parametized from the data are limited to those connected with the large-scale flow in the atmosphere, a substantial bias in estimates is introduced. This implies that the estimates are more representative for major cloud systems, often connected with precipitation, than the clouds in general. (Authors' abstract)
W87-06698

NUMERICAL MODEL FOR SULFUR AND NITROGEN SCAVENGING IN NARROW COLD-FRONTAL RAINBANDS: 1. MODEL DESCRIPTION AND DISCUSSION OF MICROPHYSICAL FIELDS,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
S. A. Rutledge, D. A. Hegg, and P. V. Hobbs.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 13, p 14385-14402, December 1986. 13 fig, 1 tab, 37 ref. Electric Power Research Inst. Research Agreement RP1630-45.

Descriptors: *Weather, *Path of pollutants, *Scavenging, *Atmospheric chemistry, *Model studies, *Air pollution, *Acid rain, *Sulfur, *Nitrogen, Clouds, Ammonium, Storms, Precipitation, Sulfates.

Chemical processes involving sulfur and nitrogen species in clouds and precipitation were incorporated into a diagnostic, two-dimensional numerical model for narrow cold-frontal rainbands (NCFR). The chemical species include sulfur dioxide, sulfate, ammonium, nitric acid, hydrogen peroxide and peroxyacetyl nitrate. The model is initialized through specification of the airflow field, a temperature-humidity sounding, and initial profiles of the various chemical species. Outputs of the model are the steady-state, two-dimensional fields of the mass mixing ratio of various chemical species (e.g., cloud water sulfate or nitrate, precipitation sulfate or nitrate). In view of similarities between NCFR and moderately strong convective systems, this model should also be useful in diagnostic studies of the sulfur and nitrogen chemistry of a variety of convective clouds and storms. (See also W87-06700) (Authors' abstract)
W87-06699

NUMERICAL MODEL FOR SULFUR AND NITROGEN SCAVENGING IN NARROW COLD-FRONTAL RAINBANDS: 2. DISCUSSION OF CHEMICAL FIELDS,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
D. A. Hegg, S. A. Rutledge, and P. V. Hobbs.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 13, p 14403-14416, December 1986. 30 fig, 5 tab, 21 ref. Electric Power Research Institute research agreement RP1630-45.

Descriptors: *Precipitation, *Model studies, *Scavenging, *Atmospheric chemistry, *Acid rain, *Air pollution, *Sulfur, *Nitrogen, Sulfates, Deposition, Oxidation, Nitrates, Prediction, Sulfur compounds.

A kinematic, diagnostic model of the physics and chemistry of narrow cold-frontal rainbands was used to explore chemical interactions within convective precipitation systems. Cloud microphysical and dynamical processes were found to be comparable with chemical processes in affecting chemical deposition. In-cloud sulfate production contributes up to 50 percent of wet sulfate deposition. Hydrogen peroxide appears to be the primary oxidant for the production of sulfate in clouds, but the sulfate production is not a linear function of H2O2 concentration, and different sulfate production mechanisms can dominate at different heights in a cloud system. The model predicts that the relationships between sulfur input and sulfate deposition, and nitrogen input and nitrate deposition in narrow cold-frontal rainbands, are, in general, nonlinear. Under certain conditions the model shows that chemical species, particularly SO2, can be redistributed over significant heights by convective cloud systems. The model predicts concentrations of chemical species in precipitation that are similar to the limited field observations that are available. (See also W87-06699) (Authors' abstract)
W87-06700

OZONE-INDUCED OXIDATION OF SO2 IN SIMULATED CLOUDS,
Nevada Univ. System, Reno. Desert Research Inst.
D. F. Miller, A. W. Gertler, M. R. Whitbeck, and D. Lamb.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 13, p 14439-14444, December 1986. 4 fig, 2 tab, 18 ref. Electric Power Research Institute contract RP1434-3.

Descriptors: *Atmospheric chemistry, *Oxidation, *Acid rain, *Precipitation, *Clouds, *Air pollution, *Sulfur, *Ozone, Scavenging, Kinetics, Sulfates.

One important aspect of acid deposition is the additional sulfate and hydrogen ions formed in cloud water by SO2 oxidation. Common atmospheric oxidants, such as ozone, nitrogen dioxide, and hydrogen peroxide, show potential for promoting rapid oxidation of sulfur dioxide in aqueous solution, whereas these same oxidants do not react with SO2 in the gas aqueous-phase rates of SO2 oxidation would have to be much larger than gas-phase rates if they are to add significantly to the preexisting sulfate conducted to measure the rate of conversion of gaseous SO2 to aqueous sulfate under conditions of warm-cloud formation. The rate of SO2 conversion in cloudy air with 140 ppb ozone was approximately 1000 times faster than conversion in clouds without ozone. The rates of SO2 oxidation observed in these experiments with simulated clouds (pH 4.5-5.5) and ozone concentrations in the range of 25-430 ppb are consistent with previously published kinetics for SO2 in bulk-water experiments with much higher concentrations of ozone. (Authors' abstract)
W87-06701

CONSIDERATIONS REGARDING SOURCES FOR FORMIC AND ACETIC ACIDS IN THE TROPOSPHERE,
Virginia Univ., Charlottesville. Div. of Urban and Environmental Planning.

W. C. Keene, and J. N. Galloway.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 13, p 14466-14474, December 1986. 3 fig, 4 tab, 65 ref.

Descriptors: *Air pollution sources, *Clouds, *Precipitation, *Organic acids, Acetic acid, *Formic acid, *Air pollution, *Acid rain.

Formic acid and acetic acid are important chemical constituents of cloud water and precipitation, but sources for these compounds in the atmosphere are at present unknown. The question of source identification was addressed through the analysis of 465 samples of precipitation collected at 14 continental and marine locations around the world. Continental precipitation during growing seasons contained, relative to marine precipitation and to continental precipitation during nongrowing seasons, higher absolute concentrations of organic acids and higher ratios of HCOOsubT (HCOOHaq + HCOO(-)) to CH3COOsubT (CH3COOHaq + CH3COO(-)). The concentrations of HCOOsubT and CH3COOsubT in precipitation at most locations were also highly correlated. These results support the hypothesis that organic acidity in precipitation may originate with two major sources, volatile vegetative constituents over continents and a second weaker source in both continental and marine regions. Relative to the similar ratios of HCOOsubT to CH3COOsubT in the aqueous phase, differences in precipitation pH resulted in large regional differences in calculated equilibrium vapor phase concentrations. The mechanism(s) by which proportionate concentrations of HCOOsubT and CH3COOsubT are maintained in the aqueous phase remains an open question. Comparisons between precipitation in impacted and remote regions indicate that although possibly important near large population centers, anthropogenic emissions are probably not major sources for organic acids in precipitation over broad geographic regions. (Authors' abstract)
W87-06702

STRATOSPHERIC AEROSOLS AND THE INDIAN MONSOON,
Illinois Univ. at Urbana-Champaign. Dept. of Physics.
P. Handler.
Journal of Geophysical Research (D)JGRDE3, Vol. 91, No. 13, p 14475-14490, December 1986. 3 fig, 10 tab, 59 ref, 3 append.

Descriptors: *Model studies, *Precipitation, *Aerosols, *Monsoons, Weather patterns, Volcanoes, India, El Nino.

The interannual variability of the Indian summer monsoon has always been a mystery. The association between stratospheric aerosols and Indian monsoon precipitation if reported. It was found that low-latitude aerosols precede below-average precipitation and high-latitude aerosols precede above average precipitation. A chi-squared analysis shows the association above the 99 percent level of significance. The transformation of low-latitude aerosols into high-latitude aerosols as they move poleward in the second year of existence. The model predicts that below average monsoon precipitation of the first year after a low-latitude eruption would be followed by above average monsoon precipitation in the second year. The findings support the prediction. Below average monsoon years are twice as likely to be followed by above average monsoon years as by below average monsoon years. Because aerosol research suffers from inadequate reporting of the events, this study uses El Nino events as a proxy for the presence of low-latitude stratospheric aerosols. There is a high level statistical association (greater than 98 percent) between the presence of low-latitude stratospheric aerosols and El Nino events. While 22 moderate and strong El Nino events were tested, six were not useful due to the presence of interfering aerosols. Thirteen of the 16 events without interferring aerosols showed the proper sequence of below average then above average monsoon precipitation. An analysis of 1942-1984 data, when aerosol data were more complete, demonstrates that the Indian monsoon fits the stratospheric forcing model very closely. The forcing of a low-latitude aerosol is assumed equivalent to a decrease in solar radiation in that both reduce the equator-to-pole temperature gradient. A small change in solar radiation can produce a large change in monsoon precipitation. The long term, secular behavior of Indian monsoon precipitation can be related to the frequency of low-latitude volcanic eruptions. (Author's abstract)
W87-06703

ANTHROPOGENIC NITROGEN OXIDE TRANSPORT AND DEPOSITION IN EASTERN NORTH AMERICA,
Massachusetts Inst. of Tech., Cambridge. Energy Lab.
For primary bibliographic entry see Field 5B.
W87-06741

WASHOUT RATIOS OF NITRATE, NON-SEA-SALT SULFATE AND SEA-SALT ON VIRGINIA KEY, FLORIDA AND ON AMERICAN SAMOA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 5B.
W87-06742

STATISTICAL SUMMARY AND ANALYSES OF EVENT PRECIPITATION CHEMISTRY FROM THE MAP3S NETWORK, 1976-1983,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
M. T. Dana, and R. C. Easter.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 113-128, January 1987. 6 fig, 9 tab, 10 ref. DOE Contract DE-AC06-76RLO 1830; EPA Interagency agreement EPA-DW930059.

Descriptors: *Statistical analysis, *Acid rain, *MAP3S network, *Chemistry of precipitation, *Seasonal variation, *Path of pollutants, *Precipitation, Nitrates, Sulfur, Ammonium, Ions, Calcium.

The MAP3S precipitation chemistry network base of event chemistry data includes nine sites widely distributed over the northeastern quadrant of the United States. Eight of these sites now have a period of record of at least 5 years. Four species (total sulfur, NO3(-), H(+) and NH4(+)) account for the bulk of ionic equivalents at seven inland sites; Ca(2+) is nearly as important as NH4(+) at several of the inland sites, and sea salt species are major components at the two coastal sites. Average pH values (from arithmetic mean H(+)) range from 4.03 to 4.24 over the network. Time trend analyses for the period for sulfur and H(+) show a consistent decrease, but the decrease is quite small and has low statistical significance; NO3(-) and NH4(+) show similar though less consistent trends. Significant seasonal trends (summer maximum, winter minimum) are found at most sites for sulfur and NH4(+); NO3(-) has a much weaker seasonal trend except at the coastal sites. Species pair correlations are strong among the four major ions, with the exception of correlations involving H(+) at sites where crustal species are more important (Illinois, Ohio). Correlations can qualitatively be explained by common sources (crustal, sea-salt, anthropogenic), polluted vs nonpolluted events, and strong seasonal trends. (Author's abstract)
W87-06743

SPATIAL AND HISTORICAL TRENDS IN ACIDIC DEPOSITION: A GRAPHICAL INTER-SITE COMPARISON,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-06744

DIFFERENCE BETWEEN SO4(2-) AND NO3(-) IN WINTERTIME PRECIPITATION,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
J. M. Dasch.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 137-141, January 1987. 2 fig, 4 tab, 113 ref.

Descriptors: *Acid rain, *Precipitation, *Path of pollutants, *Nitrates, *Sulfates, *Michigan, *Snow, Scavenging, Weather data collections, Winds, Storms, Temperature, Ice, Clouds, Oxidation.

Winter rains have lower NO3(-) levels but higher SO4(2-) levels than snows in the NE United States. Four years of winter precipitation data from SE Michigan were examined to help understand these differences. Although NO3(-) levels were indeed higher in snow than winter rain, the higher concentrations could be attributed to the generally lower precipitation depths associated with snow events than with rain events. The NO3(-) concentrations are inversely correlated with precipitation depth. There was no evidence that snow scavenged HNO3 in the air more efficiently than rain. Conversely, SO4(2-) was far higher in winter rain than in snow. This could not be explained in terms of ground-level ambient S concentrations or the wind direction from which the storm originated. However, the cloud temperatures were high enough in the case of rain to suggest that the cloud hydrometeors could have been present as liquid droplets rather than ice crystals. The SO4(2-) concentrations of the precipitation were highly correlated with the temperatures of the cloud layers. The data suggest that SO2 is incorporated and oxidized to SO4(2-) in clouds most efficiently when the hydrometeors are present as liquid droplets. The fact that NO3(-) does not show the same relationship suggests that incorporation of N species into cloud water followed by oxidation is not as important a process for N as for S. (Author's abstract)
W87-06745

IN SITU MEASUREMENTS AND RADAR OBSERVATIONS OF A SEVERE STORM: ELECTRICITY, KINEMATICS, AND PRECIPITATION,
Rice Univ., Houston, TX. Dept. of Space Physics and Astronomy.
G. J. Byrne, A. A. Few, M. F. Stewart, A. C. Conrad, and R. L. Torczon.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 1, p 1017-1031, January 1987. 9 fig, 51 ref. NSF Grants ATM-8111715 and ATM-8016164, NASA Grant NAGW-482. ONR Contract N00014-75-C-0139.

Descriptors: *Storms, *Thunderstorms, *Electrical studies, *Electric fields, *Cloud physics, *Precipitation, Weather data collections, Oklahoma, Geophysics, Field tests, Measuring instruments, Weather, Radar, Radiosondes, Clouds.

Electric field measurements were made inside an electrically active cell of a multicelled severe thunderstorm in Oklahoma with a free balloon-borne instrument. The electrical measurements are analyzed in conjunction with standard weather radar and Doppler radar observations and standard meteorological measurements of the radiosonde in order to relate the inferred electrical structure with the precipitation and kinematic features of the cell. The precipitation and kinematic characteristics of the storm are consistent with those of the general model for a 'typical' multicelled severe storm in a mature stage. The cell exhibited a bipolar charge structure with negative charge below the positive charge, which was distributed throughout the upper portion of the cloud. The average charge concentrations of the two regions were estimated to be -1.2 and 0.15 nC/cu m, respectively. The upper positive charge was approximately 6 km in vertical extent, nonuniformly distributed, and was coincident with generally upward moving air. The lower negative charge was less than 1 km in vertical extent, centered near the -9 C atmospheric temperature level, and coincident with downdraft air in moderate precipitation. Near the top of the negative region, concentrated charge of approximately 17 nC/cu m was measured with a vertical extent of at least 40 m. A screening layer of negative charge was detected at the upper boundary of the cloud. The layer was 200-250 m thick with an average charge concentration of -1.5 nC/cu m. (Author's abstract)
W87-06782

ISOTOPIC COMPOSITION OF PRECIPITATION AT MOHONK LAKE, NEW YORK: THE AMOUNT EFFECT,
City Coll., New York. Dept. of Earth and Planetary Sciences.
S. D. Gedzelman, J. R. Lawrence, J. W. C. White, and D. Smiley.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 1, p 1033-1040, January 1987. 2 fig, 4 tab, 23 ref. NSF Grant ATM 83-13954.

Descriptors: *Precipitation, *Storms, *Isotope studies, *Meteorological data collection, *Mohonk Lake, *Rainfall, Water stress, Trees, Conifers, Dansgaard amount effect, Seasonal variation, New York, Convective precipitation, Cyclonic precipitation, Precipitation excess, Deuterium, Heavy water.

The deuterium/hydrogen ratios, expressed in terms of deltaD, of precipitation at Mohonk Lake, New York, from 118 individual storms during the six summers 1977-1982 were measured and considered in light of the concurrent meteorological conditions. The so-called amount effect of Dansgaard, which says that summers with above average precipitation totals tend to have below average deltaD values, is observed at Mohonk Lake and is also registered in the tree ring cellulose of water-stressed Eastern White Pine. A similar amount effect is also observed for individual events and can be explained in terms of differences between convective and cyclonic precipitation. Stable cyclonic precipitation has much lower deltaD values (-64.8) but much greater amounts (3.77 cm) on average than purely convective storms (deltaD = -27.2, 1.30 cm). The seasonal amount effect is related to the fact that during the 6-year observational period, wetter than normal summers at Mohonk Lake also had higher than normal percentage of stable cyclonic precipitation and a lower than normal percentage of purely convective precipitation. (Author's abstract)
W87-06783

COMPARATIVE SNOW ACCUMULATION AND MELT DURING RAINFALL IN FORESTED AND CLEAR-CUT PLOTS IN THE WESTERN CASCADES OF OREGON,
Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 2C.
W87-06824

MATHEMATICAL MODELS OF RAINSTORM EVENTS IN SPACE AND TIME,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe, and P. S. Eagleson.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 181-190, January 1987. 5 fig, 3 ref, 2 append. NSF Grant ATM-8420781.

Descriptors: *Rainfall, *Storms, *Spatial distribution, *Temporal distribution, Poisson ratio, Model studies, Rainfall intensity.

The spatial and temporal structure of rainfall from storm events was investigated using point process techniques. Cells are assumed to be distributed in space either independently according to a Poisson process, or with clustering according to a Neyman-Scott scheme. Cells are born randomly through the storm and their rain is spread in time and space according to functions which may include random parameters. Two processes were studied: the rainfall intensity process which in reality is never measured and the cumulative rainfall process through the life of the storm. The mean, variance, and covariance structure are obtained for both processes under the different assumed models. (Author's abstract)
W87-06828

SOUTHERN HEMISPHERE ATLAS OF 1-MINUTE RAINFALL RATES,
Air Force Geophysics Lab., Hanscom AFB, MA.
P. Tattelman, and D. D. Grantham.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as AD-A145 42. Price codes: A05-PC in papercopy, A01-MF in microfiche. Air Force Report No. AFGL-TR-83-0285, 1984. 81 p, 31 fig, 4 tab, 6 ref.

Descriptors: *Rainfall rate, *Model studies, *Meteorology, *Southern hemisphere, Rainfall simulators, Data collections, Seasonal variation.

A model for estimating 1-minute rainfall rates at a location for which routine climatic data are available was used to produce this atlas. Even though data were available for 483 locations, considerable subjectivity and smoothing of the analyses was required because of the low station-density in most areas. Southern Hemisphere analyses of rainfall rates equalled or exceeded 0.01, 0.05, 0.10, 0.50, and 1.0% of the time are presented for four mild-season months. Analyses of the highest rainfall rates for the same frequencies of occurrence regardless of the month in which they occur, and companion analyses of the month in which the highest rate occurs, are also presented. (Author's abstract)
W87-06844

ESTIMATION OF THE POTENTIAL AND PROBABLE SOURCE REGIONS FOR ACID PRECIPITATION,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5B.
W87-06994

RAIN EVENTS IN AN ARID ENVIRONMENT - THEIR DISTRIBUTION AND IONIC AND ISOTOPIC COMPOSITION PATTERNS: MAKHTESH RAMON BASIN, ISRAEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
R. Nativ, and E. Mazor.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 205-237, January 1987. 12 fig, 6 tab, 25 ref, 3 append.

Descriptors: *Rainfall, *Israel, *Arid climates, *Seasonal variation, *Ions, *Makhtesh Ramon Basin, *Isotope studies, Oxygen, Salts.

Forty-six individual rain events and successive fractions of these events were studied with a network of instruments in the arid Makhtesh Ramon Basin, southern Israel, during 1981/1983. Annual rainfall varied from 47 to 107 mm, number of rain events varied from 8 to 20 per year, start of the rainy season varied from September to January, termination of the rainy season varied from March to May and length of the rainy season varied from 4 to 9 months. About 85% of the rain events were recorded at more than one station, indicating an aerial distribution exceeding 20 km. A cliff amount effect was observed - the rain on the cliff (800m) was 73% more than the rain at the bottom of the Makhtesh (500m). Dust samples revealed the following soluble ions (in equivalents): Ca(2+) >> Mg(2+) > Na(+) >> K(+) and HCO3(-) > Cl(-) > SO4(2-). The dust also contained CaCl2. Rain composition of 61 analyzed samples revealed (in equivalents): Ca(2+) > Na(+) > Mg(2+) >> K(+) and HCO3(-) > Cl(-) > SO4(2-), neutral pH of 7.1-7.6, and presence of CaCl2. A similar pattern was observed in 54 samples collected during the same period at Sde Boker, 30 km north of the Ramon, thus typifying the Negev Heights. Two distinct sources of dissolved ions were inferred: dust, providing mainly Ca(HCO3)2, and cloud-borne sea spray, providing mainly Na(+), Mg(2+), Cl(-) and SO4(2-). A chemical and isotope effect was observed - the rain of the rainier year contained 34% less dissolved ions and was isotopically lighter in delta 18O by 54% than the rain of the less rainy year. A chemical and isotopic front effect was observed - the first fraction of the individual rain events contained more dissolved ions (32%-69%) and was enriched by more delta 18O (31%) than the subsequent rain fractions. The observed rain distribution and chemical isotopic effects are discussed in terms of input sources, evaporation processes and altitude effects. The obtained data define rain and salt inputs into the hydrological systems. (Author's abstract)
W87-07064

WIDTH AND MOTION OF A RAIN/SNOW BOUNDARY,
Atmospheric Environment Service, Downsview (Ontario).
R. E. Stewart, and G. M. McFarquhar.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 343-350, February 1987. 7 fig, 13 ref.

Descriptors: *Rain, *Snow, *Meteorology, *Rain-snow boundaries, *Precipitation, *Boundary processes, *Model studies, *Precipitation rate, Atmosphere, Mathematical study, Mathematical equations, Mathematical models, Boundaries, Boundary conditions, Snowflakes, Temperature gradient, Relative humidity, Humidity, Numerical analysis, Prediction.

A rain/snow boundary moves towards the adjacent rain region owing to the progressive cooling of the atmosphere caused by melting snow. The dependence of the width and speed of the boundary on the initial lapse rate, the size of the largest snowflake, the snowflake density, the precipitation rate, and on the horizontal temperature gradient is determined using a numerical model. The dependence on relative humidity is explained quantitatively. The results from these calculations predict speeds of about 0.5 meters/second and widths of about 10 kilometers after 2 days using reasonable values of the governing parameters in a precipitation rate of 1 millimeter/hour. (Author's abstract)
W87-07114

SPATIAL AND TEMPORAL ANALYSIS OF THE RECENT DROUGHT IN THE SUMMER RAINFALL REGION OF SOUTHERN AFRICA,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
M. C. Dent, R. E. Schulze, H. M. M. Wills, and S. D. Lynch.
Water S. A. WASADV, Vol. 13, No. 1, p 37-42, January 1987. 9 fig, 2 tab, 22 ref.

Descriptors: *Drought, *Data interpretation, *Statistical analysis, *Rainfall, *Temporal distribution, *Spatial distribution, Economic aspects, Graphical methods.

A technique was developed to depict spatially the extent, relative severity and location of the areas most affected by the drought in the period ending 1982/83. This form of analysis (using data from 2400 long term rainfall stations) showed that large parts of the country were severely affected in the recent drought. However, it was also apparent that in many parts of the country the summer rainfall totals for this period were considerably higher than the lowest on record. It is necessary to have a comprehensive distribution of rainfall stations in order to properly assess the spatial extent of a drought. Large-scale extrapolation from a small and scattered base of stations can lead to gross errors in the spatial assessment. Of particular concern in this regard is the analysis which precedes the allocation of drought aid to agriculture. Finally, it must be stressed that it is by no means certain that the drought of the 1980's has been broken by the relatively good rains which fell in the summer of 1984/85. (Airone-PTT)
W87-07153

ISOTOPIC EVIDENCE FOR CLIMATIC INFLUENCE ON ALLUVIAL-FAN DEVELOPMENT IN DEATH VALLEY, CALIFORNIA,
Texas Tech Univ., Lubbock. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W87-07159

USE OF RADAR FOR PRECIPITATION MEASUREMENTS,
Texas A and M Univ., College Station. Dept. of Meteorology.
G. L. Huebner.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 77-100, 8 fig, 11 ref.

Descriptors: *Radar, *Precipitation, *Remote sensing, *Rainfall rates, *Measuring instruments, Rainfall intensity, Precipitation intensity.

Of the many techniques in use to determine rainfall patterns as well as integrated total rainfall, radar instrumentation is the most preferred. Its ability to give spatial coverage of instantaneous precipitation rates is only exceed by new techniques that enable spatial averaging, coupled with temporal integrations, to give true totals for selected areas. It must be realized that radar presentations are depictions of instantaneous back-scattered microwave energy that relate to the numbers and sizes of water or ice scatterers within the radar-sampled volume. The amount of back-scattered energy is related to the precipitation rate for each resolution element in the radar presentation. Because of this an instantaneous radar rainfall rate can, of course, differ from a like volume only one sample away by several orders of magnitude. This may be due simply to the non-homogeneity of rainfall or to incomplete filling of the sampled volume by scatters. Hydrologists are usually interested in the integrated precipitation for an area over a particular time period. It is for this reason that it is stressed in this chapter that the radar returns be digitized, and computer-aided integrations be performed either later or in near real time. Errors due to attenuation will be discussed and the chapter includes illustrations of drastic attenuation caused by the extreme wavelength dependence. In addition the chapter will present a technique to compensate for simple attenuation due to an intervening rain cell. Radar is a very useful tool but, like all such items, must be handled knowingly. It is no panacea for all precipitation determinations. There are certain to be errors, but with care much valuable information can be obtained. (See also W87-07346) (Lantz-PTT)
W87-07350

IN-CLOUD PROCESSES FOR SULFUR TRANSFORMATION AND SCAVENGING,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
V. K. Saxena.
Available from the National Technical Information Center, Springfield, Virginia, 22161 as DE84 014155. Price codes: A03 in paper copy, and A01 in microfiche. Final Report, June 1, 1984. Report No. DOE/EV/10498--1. 23 p, 5 fig, 5 tab, 20 ref. DOE Contract DE-A505-81EV10498.

Descriptors: *Acid rain, *Scavenging, *Nucleation, *Cloud physics, *Cloud condensation nuclei, *Sulfur, Air pollution, Water pollution sources, Aerosols, Nucleation, Clouds.

The Multi-State Atmospheric Power Production Pollution Study (MAP3S) field data was comprehensively analyzed under the proposed program to determine: (1) why are cloud condensation nuclei (CCN) enriched in the subcloud layer; (2) what fraction of sulfate aerosols burden in the subcloud layer constituted CCN; and (3) how effective is the cloud nucleation process in accounting for the sulfate contents of the cloud water. It was found that clouds influence the aerosol dynamics in the subcloud layer. The large variations of the CCN spectra observed directly below the cloud base suggest that there are particular regions near the cloud base that are favorable for accumulation of cloud active particles. These regions may be areas of local downdraft where converging air flow and evaporation of droplets may account for peaks in CCN concentrations. Evaporating clouds produced higher concentrations of CCN at smaller and larger super-saturations alike. No satisfactory explanation of this phenomena yet exists although modeling and experimental efforts have been made. The data showed that in only one case, nucleation by subcloud aerosol particles can account for the entire sulfate content detected in the cloud water samples. In other cases, indirect evidence indicates that processes other than nucleation contribute to the sulfate content of the cloud water. (Author's abstract)
W87-07417

MATHEMATICAL MODEL FOR RAIN DROP DISTRIBUTION AND RAINFALL KINETIC ENERGY,
Hebrew Univ., Rehovoth (Israel). Dept. of Soil and Water Sciences.
Y. Mualem, and S. Assouline.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 494-500, March-April 1986. 8 fig, 2 tab, 27 ref.

Descriptors: *Kinetics, *Model studies, *Rainfall distribution, *Soil erosion, *Mathematical models, Regression analysis, Calibrations, Rhodesia, Washington, Rainfall, Prediction.

An analytical function is proposed for representing the rain drop size distribution. The function can be easily differentiated to yield the drop size density distribution function and allow two different and rather simple ways of fitting to measured data either by using the observed inflection point or any other two points on the measured distribution curve. A modified weighted regression procedure is developed for best fitting the proposed function to experimental data. Using rain drop distributions measured in Rhodesia and in Washington, DC, it was possible to calibrate the model for each place. Analysis of the results indicates that the dependence of the rain drop distributions upon the rainfall intensity can be modeled very well for both sets of data. Applying the calibrated model together with a continuous function of the terminal velocity versus the drop size, it was possible to predict systematically the kinetic energy per unit mass, dE/dM, and per unit time dE/dt, as a function of rainfall intensity, I. The predicted curves of dE/dM differ significantly from the known empirical functions that were proposed to represent the measured data. The deviation between the predicted curves of dE/dt versus I in Rhodesia and Washington, DC is insignificant at low rainfall intensity but becomes noticeable at high values of I. (Author's abstract)
W87-07457

LOW- AND MIDLEVEL CLOUD ANALYSIS USING NIGHTTIME MULTISPECTRAL IMAGERY,
Air Force Geophysics Lab., Hanscom AFB, MA.
For primary bibliographic entry see Field 7B.
W87-07505

RELATIONSHIP BETWEEN DECREASED TEMPERATURE RANGE AND PRECIPITATION TRENDS IN THE UNITED STATES AND CANADA, 1941-80,
National Climatic Center, Asheville, NC.
T. R. Karl, G. Kukla, and J. Gavin.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1878-1886, December 1986. 2 fig, 3 tab, 20 ref. DOE Grant DE-FG02-85ER60372.

Descriptors: *Precipitation trends, *Climatology, *Temperature effects, United States, Canada, Monte Carlo method, Rainfall, Temperature, North America.

Previous work has shown significant decreases of the diurnal temperature range (1941-80) across a network of 130 stations in the United States and Canada. In the present study, changes in monthly total precipitation at these same stations were related to the decrease in temperature range using various Monte Carlo tests. These tests indicate that factors other than those related to precipitation contributed to the decrease of daily temperature range. Further study of the mechanisms responsible for the decreased temperature range is warranted, based on these results. The decreased range may be one of the few pieces of evidence available in North America that is consistent with potential impacts of increased greenhouse gases and/or anthropogenic aerosols. (Author's abstract)
W87-07506

POTENTIAL URBAN EFFECTS ON PRECIPITATION IN THE WINTER AND TRANSITION SEASONS AT ST. LOUIS, MISSOURI,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 4C.
W87-07507

AEROSOLS IN POLLUTED VERSUS NON-POLLUTED AIR MASSES: LONG-RANGE TRANSPORT AND EFFECTS ON CLOUDS,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
R. F. Pueschel, C. C. Van Valin, R. C. Castillo, J. A. Kadlecek, and E. Ganor.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1908-1917, December 1986. 3 fig, 6 tab, 20 ref.

Descriptors: *Cloud physics, *Cloud chemistry, *Aerosols, *Path of pollutants, *Air pollution, *Acid rain, New York, Transport, Clouds, Case studies, Nitrates, Sulfates, Ammonium, Ions.

To assess the influence of anthropogenic aerosols on the physics and chemistry of clouds in the northeastern United States, aerosol and cloud-drop size distributions, elemental composition of aerosols as a function of size, and ionic content of cloud water were measured on Whiteface Mountain, New York, during the summers of 1981 and 1982. In several case studies, the data were cross-correlated with different air mass types-background continental, polluted continental, and maritime-that were advected to the sampling site. The results are the following: (i) Anthropogenic sources hundreds of kilometers upwind cause the small-particle (accumulation) mode number to increase from hundreds to thousands per cubic centimeter and the mass loading to increase from a few to several tens of micrograms per cubic meter, mostly in the form of sulfur aerosols. (ii) A significant fraction of anthropogenic sulfur aerosols appears to act as cloud condensation nuclei (CCN) to affect the cloud drop concentration. (iii) Clouds in Atlantic maritime air masses have cloud drop spectra that are markedly different from those measured in continental clouds. The drop concentration is significantly lower, and the drop size spectra are heavily skewed toward large drops. (iv) Effects of anthropogenic pollutants on cloud water ionic composition are an increase of nitrate by a factor of 50, an increase of sulfate by more than one order of magnitude, and an increase of ammonium ion by a factor of 7. The net effect of the changes in ionic concentrations is an increase in cloud water acidity. An anion deficit even in maritime clouds suggest an unknown, possibly biogenic, source that could be responsible for a pH below neutral, which is frequently observed in nonpolluted clouds. (Author's abstract)
W87-07508

EVALUATING PRECIPITATION MODIFICATION UNDER DROUGHT CONDITIONS FOR UTAH AGRICULTURE,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 3B.
W87-07509

FURTHER EXPLORATORY ANALYSIS OF THE BRIDGER RANGE WINTER CLOUD SEEDING EXPERIMENT,
Bureau of Reclamation, Montrose, CO.
For primary bibliographic entry see Field 3B.
W87-07510

AIRCRAFT OBSERVATIONS OF TRANSPORT AND DIFFUSION IN CUMULUS CLOUDS,
North Dakota Univ., Grand Forks.
For primary bibliographic entry see Field 3B.
W87-07511

METHOD FOR COUPLING A PARAMETERIZATION OF THE PLANETARY BOUNDARY LAYER WITH A HYDROLOGIC MODEL,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-07512

URBAN-RELATED NOCTURNAL RAINFALL ANOMALY AT ST. LOUIS,
Illinois State Water Survey Div., Champaign. Cli-

matology and Meteorology Section.
S. A. Changnon, and F. A. Huff.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1985-1995, December 1986. 8 fig, 7 tab, 16 ref. NSF Grant ATM83-05502.

Descriptors: *Climatology, *Urban areas, *Seasonal variation, *Rainfall, Saint Louis, Missouri, Storms, Clouds, Convection.

Studies during the Metropolitan Meteorological Experiment (METROMEX) sought to define influences of St. Louis on the summer atmosphere that led to alterations in rainfall. These studies defined how city influences caused an afternoon maximum of rainfall east of the city. Rain data indicated a second rain maximum northeast of the city during the 2000-2400 CDT period. Study of this nocturnal maximum revealed a 58% localized rain increase, relative to the mean rainfall in the 5200 sq km network. The anomaly was present in all summers from 1971-1975. The northeast rain maximum is preceded by a local increase beginning 2 h earlier and 30 km west over the urban-industrial area. Most northeast anomaly-related storms were found to move either from the southwest (from over the urban area) or from the west-northwest (from a major industrial area), and to produce heavy rainfall rates; 19 storms moved from St. Louis between 2100-2400 and these produced 69% of the rainfall in the maximum rainfall area. The afternoon and nocturnal maximum both occurred when the entire area was receiving relatively heavy rainfall indicating that urban influences are most effective during relatively heavy rainfall conditions. All of the nocturnal anomaly rainfall occurred with well-organized convective systems. The individual convective raincells which led to heavy rainfall in the anomaly typically began over the urban industrial area and ended in the anomaly area. The raincell areas, volumes, and intensities were much greater than rural raincells. Collectively, the results strongly suggest that the nocturnal anomaly is a result of urban influences that affect a few of the heavier rain events. (See also W87-07507) (Author's abstract)
W87-07513

NUMERICAL MODELING OF HAILSTONE GROWTH. PART I: PRELIMINARY MODEL VERIFICATION AND SENSITIVITY TESTS,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
R. D. Farley, and H. D. Orville.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 2014-2035, December 1986. 10 fig, 2 tab, 58 ref. NSF Grants ATM-7916147, ATM-8311548, ATM-8516940 and ATM-8603308; NCAR Contract C7600 Subcontract NCAR S5011.

Descriptors: *Model studies, *Hail, *Numerical simulation, *Clouds, *Climatology, *Ice, Simulation, Calibrations, Cloud seeding, Rainfall.

A model is described in which cloud water, cloud ice and rain are treated via standard parameterization techniques. The precipitating ice field is discretized into 20 logarithmically spaced size categories which evolve in the time-dependent dynamic framework. Growth of ice particles is based on wet and dry growth concepts applied to the continuous accretion process. The model was used to simulate a severe supercellular hailstorm from the National Hail Research Experiment. The simulations indicate many areas of agreement between the model results and observations including the characteristic sloping updraft and moving gust front, the rounded dome cloud top, the radar overhang, and the intense precipitation cascade. Not properly simulated were the persistent bounded weak echo region and the high concentrations of giant hail and associated high radar reflectivity values. The model results were also compared to and are consistent with aircraft measurements of the thermodynamic structure of the subcloud region, and the basic internal structure of hailstorms. Recirculation of hail embryos from the forward overhang back down into the leading edge of the sloping updraft was important to hail production according to both the observations and the model results. The overall effect of the cloud seeding, although dependent on the magnitude and duration of the seeding, was quite similar in all cases. The primary seeding effect was the creation of more small ice particles, most of which were carried aloft into the anvil. Dynamic effects induced by the seeding were generally insignificant. In all seeded cases the amount of hail at the surface was reduced, although the undesirable response of decreased rainfall also resulted. (Author's abstract)
W87-07514

DETERIORATION OF MARBLE STRUCTURES: THE ROLE OF ACID RAIN,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 5C.
W87-07533

RAINFALL'S THE GAME, EDUCATION'S THE AIM,
South Dakota State Univ., Brookings.
R. Keen.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 5, p 311-313, September-October 1986.

Descriptors: *Rainfall simulators, *Education, *Water conservation, *Soil erosion, *Sedimentation, *Iowa, Erosion, Erosion control, Crop production, Runoff, Administrative agencies.

Agricultural Engineer John Laflen of the USDA Agricultural Research Service in Ames, Iowa has developed a portable rainfall simulator as a tool for conservation education. The device helps demonstrate how crop residues left on a field can reduce soil erosion. Water from two overhead nozzles falls onto three tilted soil pans representing different field conditions: meadow, no tillage, and conventional tillage. By observing the obvious differences in sediment levels in the three runoffs, onlookers can easily understand soil erosion processes. Despite its simplicity, the unit is remarkably accurate, closely replicating natural rainfall in drop size, velocity, and impact energy. Design and operating specifications are described. (Author's abstract)
W87-07561

CHEMICAL RESPONSE OF SOIL LEACHATE TO ALTERNATIVE APPROACHES TO EXPERIMENTAL ACIDIFICATION,
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5B.
W87-07572

PRECIPITATION PRODUCTION IN THREE ALBERTA THUNDERSTORMS,
McGill Univ., Montreal (Quebec). Dept. of Meteorology.
R. R. Rogers, and N. K. Sakellariou.
Atmosphere-Ocean ATOCDA, Vol. 24, No. 2, p 145-168, June 1986. 10 fig, 2 tab, 26 ref.

Descriptors: *Alberta, *Precipitation rate, *Precipitation intensity, *Rainfall, *Thunderstorms, *Radar, *Hydrologic budget, Storms, Clouds, Ice, Hail, Mathematical analysis.

Radar reflectivity patterns of three large, long-lasting Alberta thunderstorms were analyzed to determine precipitation content and outflow rate as functions of time. These quantities were then used to calculate the rate at which precipitation is generated and the characteristic time of the precipitation process as functions of time. The maximum hourly-average precipitation content was approximately 0.5 Tg for one storm (Storm A) and 1 Tg for each of the other two. The maximum hourly-average outflow rate was approximately 0.5 Gg/s for Storm A and 0.8 Gg/s for the others. Each storm had two fairly well defined periods of peak precipitation production lasting about half an hour and separated by about 45 min. The characteristic time, defined as the ratio of the instantaneous precipitation content to the outflow rate, was somewhat longer on the average for one storm than for the other two, but in no case was far from 20 min, which is approximately the time required for rain to develop in cumulonimbus clouds. The total amounts of rain produced by the three storms ranged from 4 to 7 Tg. The generation rates and cumulative amounts of rain observed in the three storms are slightly smaller than most previous estimates for thunderstorms. However, it is concluded that the agreement is surprisingly close, considering the different techniques that were used over the years and the potential for error in the estimates. (Author's abstract)
W87-07591

2C. Snow, Ice, and Frost

COMPARATIVE SNOW ACCUMULATION AND MELT DURING RAINFALL IN FORESTED AND CLEAR-CUT PLOTS IN THE WESTERN CASCADES OF OREGON,
Oregon State Univ., Corvallis. School of Forestry.
S. N. Berris, and R. D. Harr.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 135-142, January 1987. 3 fig, 2 tab, 28 ref. USDA Forest Service Supplement PNW-81-310.

Descriptors: *Snow accumulation, *Forests, *Snowmelt, *Rainfall, *Cascade Range, Oregon, Vegetation, Energy, Canopy, Runoff, Winds, Heat transfer.

Snow accumulation was compared between forested and clear-cut plots in the transient snow zone of the western Cascade Range of Oregon, and measured snowmelt in both plots was compared to melt predicted by energy balance analyses. The absence of forest vegetation affected both snow accumulation and amount of energy available for melt during rainfall. Because intercepted snow melted in the forest canopy and reached the ground as meltwater, water equivalents in the clear-cut plot were commonly 2-3 times greater than those in the forested plot. During the largest rain-on-snow event of the study, measured water outflow (rain plus snowmelt) in the clear-cut plot was 21% greater than in the forested plot. Estimates made from microclimatological data show that during the common period of melt, total energy available in the clear-cut plot was 40% greater than that in the forested plot. Because of greater wind speed in the clear-cut plot, combined sensible and latent heat transfers in the clear-cut plot were nearly triple those of the forested plot. (Author's abstract)
W87-06824

WETLANDS INVESTIGATIONS ON AKERS RANCH IN BIG VALLEY, CALIFORNIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. R. Sanders, E. J. Clairain, R. F. Theriot, and P. H. Jones.
Available from the National Technical Information Service, Springfield, VA 22161as ADA 177297. Price codes: A04-PC in papercopy, A01-MF in microfiche. Miscellaneous Paper D-86-7, December 1986. Final Report. 68 p, 6 fig, 5 tab, 23 ref, 4 append.

Descriptors: *Wetlands, *Akers Ranch, *California, *Environmental effects, Vegetation, Irrigation, Water use, Wildlife habitats, Groundwater, Fisheries, Agriculture.

This study involved delineation and evaluation of wetlands, a survey of previous farming activities, and assessment of impacts of a proposed land development plan on the Robert W. Akers ranch in northeastern California. Results of the study were used by SPK to support litigation in which the property owner allegedly violated provision of Section 404 of the Clean Water Act of 1977. The first task was to delineate natural wetlands occurring on the 9,600-acre ranch. A combination of transects and perimeter wetland boundary sampling was used. Natural wetlands occurred on 2,889 acres of property. Other portions of the property were found to support wetland vegetation, existing due to a long-standing irrigation practice. However, soils in these areas did not exhibit hydric characteristics, and such areas were not

considered to be wetlands. Independent hydrologic analyses of gaging station data closely correlated with the wetland boundary developed from field sampling. Task II consisted of an assessment of the functions and values of the natural wetlands. Results indicated that the wetlands on the property rated (a) high for wildlife habitat (especially for waterfowl and other water-dependent birds), shoreline anchoring and sediment trapping, and long-term nutrient retention; (b) moderate for food chain support, groundwater discharge, and flood storage and desynchronization; and (c) low for fisheries habitat, groundwater recharge, and all active recreation functions. Of special significance was use of the wetlands by certain rare and/or endangered species. Task III involved a survey of previous farming activities on the property. Interviews with a number of local residents revealed that the wetlands have been used only for production of native marsh hay and grazing by cattle. Soil tillage has been restricted to nonwetland portions of the property. Task IV consisted of an assessment of the impacts of a proposed land development plan. The assessment revealed that the proposed activities would result in the destruction of virtually all wetlands on the property, and all functions currently provided by the wetlands would be lost. (Author's abstract)
W87-07034

WIDTH AND MOTION OF A RAIN/SNOW BOUNDARY,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W87-07114

STABLE ISOTOPE COMPOSITIONS OF FOSSIL MOLLUSKS FROM SOUTHERN CALIFORNIA: EVIDENCE FOR A COOL LAST INTERGLACIAL OCEAN,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2A.
W87-07161

SNOW AND ICE,
Institute of Hydrology, Wallingford (England).
E. M. Morris.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 153-182, 2 fig, 3 tab, 84 ref.

Descriptors: *Snow, *Ice, *Forecasting, *Hydrologic properties, *Hydrologic models, *Model studies, Flooding, Reservoir operation, Arid lands, Soil water, Evapotranspiration, Snowmelt.

Hydrological forecasting methods for areas which are covered by ice and/or snow are described. There are a wide range of direct and indirect applications for such models. For example: (1) estimates of seasonal flood risk are required to plan engineering work on rivers and to determine rocks to crops grown on the flood plain. In many parts of the northern hemisphere the risk of flooding is increased by snowmelt of precipitation as cold snow earlier in the season. Models of the accumulation and subsequent melt of snow cover in a catchment help in the assessment of the risk of snowmelt floods; (2) although reservoir management policies are designed to meed long-term objectives, short-term transient events such as spring snowmelt can have a major effect on the choice of long-term operating rules, especially for small reservoirs in the mountains. Hence real-time forecasting models with a snowmelt component are needed; (3) in arid regions bordered by high mountains (for example in Iran and northern India) snowmelt runoff is used for irrigation. Snow models may be used to estimate the volume of water stored in the mountain catchment and when it will be available for use in the plains; (4) the soil status at the end of winter is important for agriculture and the construction industry. Detailed models of snowmelt processes allow the water and heat inputs to a soil covered by snow to be calculated. In particular, the distribution of permafrost may be estimated; (5) variation in the amount of water lost by interception and evapotranspiration is an important effect on land-use change. Process-based models allow these losses to be estimated when part of the annual precipitation falls as snow; (6) the global climate is strongly influenced by high albedo areas of snow and sea ice. Thus calculations of snow cover extent form an important part of general climatological forecasting models. The basic principles of snowmelt forecasting are best explained by describing first the point site models which allow snowmelt to be calculated at a particular site and then the catchment models which are used to predict streamflow from snowmelt over a wide area. (See also W87-07346) (Lantz-PTT)
W87-07353

TILLAGE-RESIDUE EFFECTS ON SNOW COVER, SOIL WATER, TEMPERATURE AND FROST,
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 2G.
W87-07454

NUMERICAL MODELING OF HAILSTONE GROWTH. PART I: PRELIMINARY MODEL VERIFICATION AND SENSITIVITY TESTS,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W87-07514

2D. Evaporation and Transpiration

RESPONSE OF TEN CORN CULTIVARS TO FLOODING,
Agricultural Research Service, Columbus, OH. Soil Drainage Research Unit.
N. R. Fausey, T. T. VanToai, and M. B. McDonald.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1794-1797, November-December 1985. 2 fig, 4 tab, 16 ref.

Descriptors: *Flooding, *Corn, *Plant growth, *Field tests, *Irrigation effects, Crop yield, Hybrids, Cultivars, Accumulation, Growth, Nutrients, Heavy metals, Temperature, Seedlings.

Emergence, growth and mineral uptake of five inbred and five hybrid corn cultivars when flooded for 0, 2, 4 or 6 days at the pregermination and the 4-5 leaf seedling growth stages was determined. Emergence following pregermination flooding was determined under laboratory and field conditions at cold and warm temperatures during flooding. Growth and mineral uptake were determined for seedlings growing in the field and flooded at warm temperatures. Emergence percentage decreased as flooding duration and temperature increased during flooding. Dry matter per plant was reduced as flooding duration increased. Hybrid cultivars were more susceptible to flooding than inbred cultivars at both growth stages. The concentration of N, P, Ca, Mg and Cu in the plant decreased while Fe, Al, and Na increased with increased flooding. Potassium concentration peaked at 2 days of flooding then decreased, while Mn and Zn showed a reversed trend. (Author's abstract)
W87-06640

AUTOMATED SYSTEM FOR MEASUREMENT OF EVAPOTRANSPIRATION FROM CLOSED ENVIRONMENTAL GROWTH CHAMBERS,
Agricultural Research Service, Mississippi State, MS.
For primary bibliographic entry see Field 7B.
W87-06645

WATERSHED EVAPOTRANSPIRATION PREDICTION USING THE BLANEY-CRIDDLE APPROACH,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. G. Williams.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1856-1859, 1866, November-December 1985. 4 fig, 6 tab, 14 ref.

Descriptors: *Mathematical equations, *Hydrologic budget, *Water yield, *Watersheds, *Blaney-Criddle approach, *Evapotranspiration, Water use, Land use, Drainage area, Prediction, Estimating, Agricultural watersheds, Agriculture.

Estimates of water yield from predominantly agricultural land use watersheds are often the concern of watershed managers. Water yield is simply the residual of water inputs after system water demands have been met. However simple the concept of water yield, accurate estimates are difficult to obtain for ungaged areas. The Blaney-Criddle approach was applied to produce a watershed-scale estimate of evapotranspiration. The application was tested on seven Coastal Plain watersheds ranging in size from 15.7 to 334.3 sq km with mixed forest, crop, and pasture use. Seasonal and annual empirical consumptive use coefficients are presented for the test drainage areas. Also, the consumptive use coefficients were related to percentages of open water and open water/wetlands. Results indicate that this application explains in excess of 98% of the observed variation in annual and seasonal watershed evapotranspiration. (Alexander-PTT)
W87-06650

HYDROPHYSICAL MODIFICATION OF A SANDY SOIL AND ITS EFFECT ON EVAPORATION,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
R. M. El-Asswad, and P. H. Groenevelt.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1927-1932, November-December 1985. 6 fig, 3 tab, 18 ref.

Descriptors: *Evaporation, *Soil properties, *Surface sealing, *Land disposal, *Manure, Permeability coefficient, Penetration coefficient, Soil columns, Animal wastes.

A study was conducted to investigate the influence of surface treatments on evaporation from a sandy soil. Four treatments were included: Control, 0.5 kg/sq m of solid manure (applied in liquid form), 1% polyvinyl alcohol (2 L/sq m), and 1% polyvinyl acetate (2 L/sq m) applied to the surface of soil columns. Evaporation was measured in a controlled chamber. The results indicate that liquid dairy cattle manure is the most effective for reducing evaporation followed by polyvinyl acetate and polyvinyl alcohol. All materials used in the experiment increased the liquid-soil contact angle, decreased the unsaturated hydraulic conductivity and decreased the penetration coefficient. Manure and polyvinyl alcohol increased the saturated hydraulic conductivity, whereas polyvinyl acetate decreased it. The magnitude of the evaporation reduction is attributed to the influence of the different materials on these parameters. (Author's abstract)
W87-06662

SIMULATED RELATIONSHIPS BETWEEN SPECTRAL REFLECTANCE, THERMAL EMISSIONS, AND EVAPOTRANSPIRATION OF A SOYBEAN CANOPY,
San Diego State Univ., CA. Dept. of Geography.
A. S. Hope, D. E. Petzold, S. N. Goward, and R. M. Ragan.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 1011-1019, December 1986. 8 fig, 24 ref.

Descriptors: *Soybeans, *Soil-plant-atmosphere relationships, *Evapotranspiration, *Canopy reflectance, *Model studies, *Simulation, Energy, Thermal flux, Albedo, Vegetation, Canopy, Photosynthesis, Leaves, Water potential, Temperature.

A canopy reflectance model was incorporated into a routine for simulating water and energy flows in the soil-plant-atmosphere system. The reflectance model is structured to calculate canopy albedo throughout each simulation period and to determine spectral reflectances at a specified time during the day. Spectral vegetation indices are then calculated from the reflectances and related to the evapotranspiration and thermal response of the canopy. The canopy reflectance model was

also used to establish the photosythetically active radiation load at various depths in the canopy. Stomatal resistances were calculated using these radiation values and integrated to give the minimum canopy resistance. Actual canopy resistance is obtained by adjusting minimum canopy resistance for environmental stresses such as leaf water potential and leaf temperature. Using data for a soybean canopy, canopy evapotranspiration and temperatures were simulated for a range of leaf area index values and compared with the corresponding spectral vegetation indices. The results indicate that the normalized difference spectral index has an inverse linear relationship with canopy temperature, concurring with results obtained from satellite observations. The possibility of using a spectral vegetation index and thermal observations together to determine parameters for surface moisture availability for evapotranspiration was considered. (Author's abstract)
W87-06693

MODELLING CHANGES IN FOREST EVAPOTRANSPIRATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. D. Huff, and W. T. Swank.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 125-151, 5 fig, 8 tab, 40 ref.

Descriptors: *Evapotranspiration, *Forest watersheds, *Model studies, Simulation analysis, Computer models, Mathematical models, BROOK, WATBAL, PROSPER, Streamflow, Water yield.

The idea of forecasting evapotranspiration has strong appeal. It is particularly attractive to those who wish to evaluate the consequences of proposed land management actions or possible trends in climate (e.g., from elevated CO2 levels) before it is too late to avoid undesired effects. Usually, the variable of most interest is streamflow or water yield, although some agricultural models focus on estimates of plant or soil water status. In any case, water yield (or soil moisture) is determined by the difference between precipitation and evapotranspiration. One discipline where such forecasting has been attempted is forest hydrology. At the simplest level, regression models have been developed to predict changes in water yield caused by forest cutting. This approach relates percentage reduction in basal area, insolation index, and annual change in streamflow in the southern Appalachian region of the United States. An increased level of complexity involves simplified simulation models. One is the model BROOK, which has been used to simulate changes in streamflow resulting from the alteration of vegetation cover type. Other examples include PROSPER and WATBAL, the Subalpine Water Balance Model. During the study the models were used to extend experimental catchment results from study sites in regions across the United States. These extended results were used to develop a quantitative methodology for estimating changes in the evapotranspiration as a function of leaf area index and soil depth. Although other examples of evapotranspiration simulation models can be found for both forested and agricultural systems, the remainder of the chapter is devoted to examination of the PROSPER model. Three general topics are presented: discussion of the model structure and individual components, previous applications of PROSPER to studies of the effects of forest management practices, and application of the model to watershed 13 at Coweeta Hydrologic Laboratory, where data spanning a 15-year coppice regrowth period following clear-cutting are available. (See also W87-07346) (Lantz-PTT)
W87-07352

ESTIMATION OF EVAPOTRANSPIRATION BY SOME EQUATIONS UNDER HOT AND ARID CONDITIONS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Agricultural Engineering.
M. Saeed.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 434-438, March-April 1986. 9 fig, 1 tab, 6 ref.

Descriptors: *Evapotranspiration, *Alfalfa, *Arid lands, Lysimeters, Climatic data, Comparison studies, Seasonal variation, Evaporation.

The most common methods for the estimation of evapotranspiration (ET) were evaluated under a hot and arid climate, by comparing the estimates obtained, with the actual ET from 20 cm tall, well watered and dense cover of alfalfa. The reference ET was measured with stecl lysimeters (2 m x 2 m x 1.25 m in size), installed at the Agricultural Research Station of Agriculture College, King Saud University in Dirab (near Riyadh, Saudi Arabia). The climatic data, needed for estimation with the various methods, were taken from the meteorological unit of the Research Station, situated adjacent to the lysimeters. It was found that the summer ET is underestimated by all the methods, namely: Blaney-Criddle (modified), Jensen-Haise, Turc and Hargreaves methods. The winter ET is underestimated by Blaney-Criddle only, while a fair estimate of the winter ET is given by the Turc, Hargreaves and Jensen-Haise methods. Best estimates of ET are obtained with Jensen-Haise method from October to March. To obtain better results with these formulae, a new chart for k sub c values of alfalfa was prepared for use with the Blaney-Criddle method and improved coefficients were developed for the Jensen-Haise, Turc and Hargreaves methods. Coefficients were also developed for ET estimation with evaporation from 'A' pan, under hot and arid conditions. (Author's abstract)
W87-07448

ESTIMATING POTENTIAL CROP EVAPOTRANSPIRATION WITH MINIMUM DATA IN ARIZONA,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
Z. A. Samani, and M. Pessarakli.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 522-524, March-April 1986. 2 tab, 9 ref, append.

Descriptors: *Evapotranspiration, *Mathematical equations, *Alfalfa, Comparison studies, Equations, Estimating, Evaporation, Arizona, Climates, Performance evaluation.

A method of estimating potential evapotranspiration of reference crops using only temperature data was presented by Hargreaves and Samani. This paper reports on a comparison of this method with several other methods including those of Hargreaves, Jensen-Haise, modified Jensen-Haise, Penman, Blaney-Criddle, and Pan evaporation to evaluate the suitability of this method for climates similar to Mesa (Arizona). It was concluded that for climates similar to Mesa (Arizona), Hargreaves and Samini's equation can be used to estimate the monthly potential evapotranspiration of alfalfa reference crops with reasonable accuracy. (Author's abstract)
W87-07462

MODELING EVAPOTRANSPIRATION FROM SAGEBRUSH-GRASS RANGELAND,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
J. R. Wight, C. L. Hanson, and K. R. Cooley.
Journal of Range Management JRMGAQ, Vol. 39, No. 1, p 81-85, January 1986. 4 fig, 4 tab, 19 ref.

Descriptors: *Model studies, *Rangeland management, *Evapotranspiration, *Idaho, *Sagebrush, *Grasses, *Model testing, Phreatophytes, Moisture meters, Lysimeters, Soil water, Prediction, Distribution, Seasonal distribution, Hydrologic budget, Available water, Soil properties, Rainfall.

Three models (CREAMS, SPAW, and ERHYM) were used to predict evapotranspiration (ET) from a sagebrush-grass range site in southwest Idaho. Model-predicted ET was compared with ET measured by a lysimeter and ET calculated with a water-balance equation using field-measured soil water and precipitation values. There was generally good agreement between the lysimeter and water-balance calculated ET and between these ET values and model-predicted ET. Maximum averaged daily ET rates were about 2.5 mm for April, May, and June with single day ET values from the lysimeter as high as 5.0 mm. Although the CREAMS-predicted ET rates were generally higher than those predicted by SPAW and ERHYM or measured by the water-balanced method, all three models were functionally capable of simulating ET from sagebrush-grass range sites. ERHYM was the simplest of the three models to operate. (Author's abstract)
W87-07574

2E. Streamflow and Runoff

TRANSFER OF SOIL SURFACE-APPLIED CHEMICALS TO RUNOFF,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W87-06659

EVENT-BASED PROCEDURE FOR ESTIMATING MONTHLY SEDIMENT YIELDS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W87-06660

TESTS OF AN EXTENSION TO INTERNAL SEICHES OF DEFANT'S PROCEDURE FOR DETERMINATION OF SURFACE SEICHE CHARACTERISTICS IN REAL LAKES,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 2H.
W87-06673

WIND-INDUCED INTERNAL SEICHES IN LAKE ZURICH OBSERVED AND MODELED,
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W87-06674

CURRENTS IN LAKE GENEVA,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 2H.
W87-06675

COMPARISON OF TRANSFORMATION METHODS FOR FLOOD FREQUENCY ANALYSIS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
D. Jain, and V. P. Singh.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 903-912, December 1986. 5 fig, 5 tab, 18 ref.

Descriptors: *Model studies, *Flood frequency, *Flood forecasting, *SMEMAX, *Numerical analysis, *Skewness, *Kurtosis, *Statistical methods, Comparison studies, Performance evaluation, Data interpretation, Distribution, Transformation.

The SMEMAX transformation, its modified versions and power transformation were applied to 55 long-term records of annual maximum flood flows tested previously for independence, homogeneity and completeness. Even though SMEMAX transformation reduced the coefficient of skewness to near zero for flood data, their distribution was not a true normal distribution. In almost all cases, the coefficient of kurtosis was quite different from 3.0 of the normal distribution. Empirical criteria showed that SMEMAX transformation performed well only for 40 (70 percent) of the 55 stations tested. Its performance level dropped, especially for stations which had both the coefficient of skewness and kurtosis greater than 3.0 and 10.0, respectively. Power transformation was generally better in transforming the flood data to a normal distribution. It performed well for 50 (90 percent) of the 55 stations tested. The coefficient of skewness in case of the data transformed by power

transformation was much closer to the zero value than in the case of SMEMAX transformed series. The SMEMAX transformation and its two modified versions yielded identical results when flood frequency analysis was performed. Computationally, all three methods were equally simple and easy to apply for flood frequency analysis. In some cases, the coefficient of kurtosis for the transformed distributions obtained both by SMEMAX and power transformations deviated farther from that for the normal distribution than for the parent distribution. (Author's abstract)
W87-06683

SPACE-TIME MODELING OF VECTOR HYDROLOGIC SEQUENCES,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
S. J. Deutsch, and J. A. Ramos.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 967-981, December 1986. 6 fig, 5 tab, 41 ref.

Descriptors: *Vector hydrologic sequences, *Model studies, *STARIMA models, *Stream flow, *Stochastic hydrology, Networks, Autocorrelation, Hydrology.

Stochastic modeling of vector hydrologic sequences was examined with a general class of space-time autoregressive integrated moving average (STARIMA) models. The models describe spatial and temporal autocorrelation, through dependent variables lagged both in space and time. The model structures incorporate a hierarchical ordering scheme to map the vector of observations into a network configuration. The neighboring structure used introduces a physical/geographical hierarchy to enable the model identification procedures to assist in determining appropriate correlative relationships. The three-stage iterative space-time model building procedure is illustrated using average monthly streamflow data for a four-station network of the Southeastern Hydropower System. (Author's abstract)
W87-06689

SEMI-DISTRIBUTED ADAPTIVE MODEL FOR REAL-TIME FLOOD FORECASTING,
Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.
C. Corradini, F. Melone, and L. Ubertini.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 1031-1038, December 1986. 7 fig, 2 tab, 17 ref.

Descriptors: *Runoff, *Rainfall, *Model studies, *Rainfall-runoff relationships, *Flood forecasting, Rainfall intensity, Basins, Flow, Estimating, Hydrographs, Model testing, Italy, Prediction.

A semi-distributed deterministic model for real-time flood forecasting in large basins is proposed. Variability of rainfall and losses in space is preserved and the effective rainfall-direct runoff model segment based on the Clark procedure is incorporated. The distribution of losses in space is assumed to be proportional to rainfall intensity and their evolution in time is represented by the Phi-index; furthermore, an initial period without production of effective rainfall is considered. The first estimation of losses and the associated forecasts of flow are performed at the time corresponding to the first rise observed in the hydrograph. Then the forecasts of flow are corrected at each subsequent time step through the updating of the Phi-index. The model was tested by using rainfall-runoff events observed on two Italian basins and the predictions of flow for lead times up to six hours agree reasonably well with the observations in each event. For example, for the coefficient of persistence, which compares the model forecasts with those generated by the no-model assumption, appreciable positive values were computed. In particular, for the larger basin with an area of 4,147 sq km, the mean values were 0.4, 0.4 and 0.5 for forecast lead times of two hours, four hours and six hours, respectively. Good performance of the model is also shown by a comparison of its flow predictions with those derived from a unit hydrograph based model. (Author's abstract)
W87-06695

FOREST HARVESTING AND WATER: THE LAKE STATES EXPERIENCE,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
For primary bibliographic entry see Field 4C.
W87-06696

COMBING HYDROLOGIC FORECASTS,
University of Western Ontario, London. Dept. of Statistical and Actuarial Sciences.
A. I. McLeod, D. J. Noakes, K. W. Hipel, and R. M. Thompstone.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 29-41, January 1987. 6 tab, 20 ref.

Descriptors: *Hydrologic models, *Forecasting, *River forecasting, *Time series analysis, *Model studies, *Streamflow forecasting, Reservoirs, Comparison studies, Case studies, Multireservoir networks.

Forecasts of river flows are useful in optimizing the operation of multipurpose reservoir systems. Using two case studies, the usefulness of combination techniques for improving forecasts is examined. In the first study, a transfer function-noise model, a periodic autoregressive model, and a conceptual model were employed to forecast quarter-monthly river flows. These models all approach the modelling and forecasting problem from three different perspectives, and each has its own particular strengths and weaknesses. The forecasts generated by the individual models were combined in an effort to exploit the strengths of each model. The results of this case study indicated that significantly better forecasts can be obtained when forecasts from different types of models were combined. In the second study, periodic autoregressive models and seasonal autoregressive integrated moving average models were used to forecast monthly river flows. Combining the individual forecasts from these two statistical time series models did not result in significantly better forecasts. (Authors' abstract)
W87-06708

MARKOV-WEIBULL MODEL OF MONTHLY STREAMFLOW,
Hartford Univ., West Hartford, CT. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-06710

SYNTHETIC UNIT HYDROGRAPH,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-06711

BIOCHEMICAL OXYGEN DEMAND OF AGRICULTURAL RUNOFF,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 5A.
W87-06718

RELATIONSHIPS BETWEEN ULTRAVIOLET ABSORBANCE AND TOTAL ORGANIC CARBON IN TWO UPLAND CATCHMENTS,
Aberdeen Univ. (Scotland). Dept. of Soil Science.
A. C. Edwards, and M. S. Cresser.
Water Research WATRAG, Vol. 21, No. 1, p 49-56, January 1987. 6 fig, 6 tab, 39 ref.

Descriptors: *Regression equations, *Ultraviolet absorbance, *Total organic carbon, *Catchment areas, *Rivers, *Streams, *Scotland, Topography, Climate, Equations, Absorbance, Storms, Monitoring.

Regression equations relating u.v. absorbance to total organic carbon (TOC) in river water were compared for streams draining two upland catchments in north-east Scotland which have similar climate, topography and land use but contrasting acidic and basic parent materials. A comparison was also made of regression equations for individual tributaries contributing to the main streams in each catchment. Reasons for observed differences are suggested. Changes in u.v. absorbance vs TOC relationships through storm events are discussed, and the problems associated with using TOC/absorbance relationships to monitor changes in TOC with time through storms are briefly considered. (Author's abstract)
W87-06754

RUNOFF VOLUME FORECASTS CONDITIONED ON A TOTAL SEASONAL RUNOFF FORECAST,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. Pei, S. J. Burges, and J. R. Stedinger.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 9-14, January 1987. 7 fig, 2 tab, 18 ref.
NSF Grant CEE-8211730.

Descriptors: *Runoff forecasting, *Model studies, *Statistical analysis, *Runoff volume, *Runoff rates, Seasonal variation, Subperiod flow, Flow, Runoff, Distribution, Prediction.

Given an imperfect forecast of the total runoff volume for a season, it is useful to determine the distribution of the forecasted runoff volume in each subperiod. A method was developed for deriving the joint distribution of the subperiod flows and the total seasonal forecast. Historical subperiod flows and the corresponding total seasonal forecast were transformed to the Gaussian domain via three-parameter lognormal transformations. The transformed subperiod flows and total seasonal forecast were modeled as multivariate normal, from which the conditional distribution of the runoff volume in each subperiod, given the total seasonal forecast, is obtained. (Author's abstract)
W87-06812

MIXED GAMMA ARMA(1,1) MODEL FOR RIVER FLOW TIME SERIES,
Malaya Univ., Kuala Lumpur (Malaysia).
C. H. Sim.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 32-36, January 1987. 1 fig, 3 tab, 9 ref.

Descriptors: *Time series analysis, *ARMA models, *Model studies, *River flow, *Streamflow, *Simulation, Correlation analysis, Malaysia, Mathematical studies.

A time series model which can be used for simulating stationary river flow sequences with high skewness and the long-term correlation structure of an ARMA(1,1) model was fitted to monthly streamflows taken from a river in Malaysia. The simulated data bear a close resemblance to the historical sequence in terms of the mean, variance, skewness, and autocorrelation coefficients. (Author's abstract)
W87-06814

MEASUREMENTS OF LARGE STREAMWISE VORTICES IN AN OPEN-CHANNEL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. S. Gulliver, and M. J. Halverson.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 115-123, January 1987. 10 fig, 1 tab, 35 ref.
NSF Contract CEE-8205078.

Descriptors: *Vortices, *Open-channel flow, *Hydrodynamics, *Flumes, *Flow measurement, Flow, Velocity, Turbulent flow, Lasers, Hydrogen.

The moving-bed flume, where the cross-sectional mean velocity is zero, has proven to be useful for visualization of coherent structures in the flow, especially streamwise vortices with a size scale equal to the depth. The temporal mean of these streamwise vortices is turbulence driven secondary motion. Hydrogen bubbles illuminated by a plane of laser light are used to visualize and measure these vortices. Flow visualization at the zero mean velocity point provides a unique view of the

streamwise vortices without the interference of the mean flow velocity. (Author's abstract)
W87-06822

METHOD OF STREAMFLOW DROUGHT ANALYSIS,
Novi Sad Univ. (Yugoslavia). Inst. of Water Resources.
E. Zelenhasic, and A. Salvai.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 156-168, January 1987. 15 fig, 5 tab, 11 ref.

Descriptors: *Streamflow, *Drought, *Model studies, *Stochastic process, *Sava River, *Tisa River, Rivers, Hydrology, Yugoslavia, Calibrations, Flow, Hydrographs.

A method of completely describing and analyzing the stochastic process of streamflow droughts was developed. All important components of streamflow droughts such as deficit, duration, time of occurrence, number of streamflow droughts in a given time interval (O,t), the largest streamflow drought deficit, and the largest streamflow drought duration in a given time interval (O,t,) are taken into consideration. A stochastic model is presented for interpretation and analysis of the largest streamflow drought deficit below a given reference discharge and the largest streamflow drought duration concerning a time interval (O,t), at a given location of a river. The method is based on the assumption that streamflow droughts are independent, identically distributed random variables and that their occurrence is subject to the Poisson probability law. This is actually a continuation of the previous E. Zelenhasic (1970, 1979, 1983) and P. Todorovic (1970) works on the extremes in hydrology. Application of the method was made on the 58-year record of the Sava River at Sr. Mitrovica and on the 52-year record of Tisa River at Senta, Yugoslavia, and good agreement was found between the theoretical and empirical distribution functions for all analyzed drought components for both rivers. Only one complete example, the Sava River at Sr. Mitrovica, is given. The proposed method deals with hydrograph recessions of daily or instantaneous discharges in the region of low flows, and not with mean annual flows which were used by other investigators. (Author's abstract)
W87-06826

ESTIMATION OF DISPERSION AND FIRST-ORDER RATE COEFT BY NUMERICAL ROUTING,
Geological Survey, NSTL Station, MS.
For primary bibliographic entry see Field 5B.
W87-06827

SIMPLIFIED, STEADY-STATE TEMPERATURE AND DISSOLVED OXYGEN MODEL: USER'S GUIDE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. L. Martin.
Available from the National Technical Information Service, Springfield, VA 22161. Instruction Report E-86-4, August 1986. Final Report. 31 p, 1 fig, 1 tab, append.

Descriptors: *Water temperature, *Dissolved oxygen, *Model studies, Computer programs, Streams, Rivers, Flow patterns, Meteorology.

Documented is the theoretical basis of simplified analytical techniques for estimating water temperature and dissolved oxygen (DO) variations in streams and rivers and provides guidance in their use. These techniques are based upon well-known analytical solutions to mass balance and constituent transport equations. The FORTRAN coding described allows application of these equations to a variety of configurations, including simple river systems, branches, and tributaries. The analytical relationships on which these techniques are based impose limitations that must be considered in the interpretation of results. These assumptions and the details of model development are discussed in the following sections. This model allows comparisons of different flow regimes, inflow loadings, and meteorological conditions on longitudinal spatial distributions of water temperatures and DO concentrations under steady-state conditions. The model has the advantage of ease of application and minimal data requirements and is appropriate where prediction of long-term or time-averaged conditions is suitable for addressing study objectives. The simplicity of the model results from certain assumptions that are detailed. (Lantz-PTT)
W87-07007

ACOP CANALS EQUILIBRIUM DATA VOLUME X: SUMMARY OF 1974-1980 DATA,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W87-07009

BED-FORM DATA IN ACOP CANALS - EQUILIBRIUM RUNS 1979-1980,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
K. Mahmood, M. H. Mehrdad, M. I. Haque, and A. M. Choudri.
Available from the National Technical Information Service, Springfield, VA 22161. Report No. EWR-84-3, November 1984. 643 p, 15 fig, 14 ref, 2 append.

Descriptors: *Data collections, *Channels, *Pakistan, *Sedimentation, *Channel morphology, Alluvial channels, Hydraulic properties, Equilibrium, Channel flow, Field test.

The field research on large sand-bed channels of Pakistan was conducted under a binational U.S.A.-Pakistan Cooperative Program. Field experiments were conducted under the Alluvial Channel Observation Project (ACOP) to obtain data on the hydraulic, sedimentation and morphologic aspects of alluvial hydraulics. This report represents the bed-form observed in ACOP canals, flowing in equilibrium states. The field experiments for equilibrium runs were conducted in straight channel reaches of about two-mile lengths. To ensure equilibrium conditions, field measurements were made only after the channel discharge had remained steady for, at least, two days. A summary of hydraulic and sediment data is, also, included herein for completeness. The bed-form data reported herein have been abstracted from 112 equilibrium experiments and represent a total off 14 miles of channel bed. (Author's abstract)
W87-07010

RIVERS OF LABRADOR,
Department of Fisheries and Oceans, St. John's (Newfoundland). Research and Resource Services.
T. C. Anderson.
Canadian Special Publication of Fisheries and Aquatic Sciences 81, Ottawa, 1985. 389 p.

Descriptors: *Rivers, *Fishing, *Labrador, *Canada, River systems, Fish, River flow, Salmon, Cold regions, Physical properties, Hydrologic properties.

Physical and biological data are presented for 120 river systems in Labrador. Based on bio-physical parameters, Labrador has been divided into six regions. A general description of each region is followed by a detailed summary of information from each individual river in that region, proceeding south to north. Past and present developments within the watersheds are documented. Physical data presented include characteristics of each drainage system, and locations and descriptions of obstructions to fish passage. Results of water quality analyses, where available, are also included. The size and location of salmonid rearing and spawning habitat are presented for 82 rivers. The distribution within Labrador of 24 freshwater, anadromous and catadromous fishes is summarized. Emphasis is placed on the production and freshwater exploitation of Atlantic salmon. Production estimates, based on available rearing habitat for salmon parr, are presented for 60 rivers. Data on Atlantic salmon angling are reported from 19 rivers and the biological characteristics of the catch, where available, are included. Data collected at counting fences on five rivers are summarized. Catch/effort data from the commercial fishery for Arctic char in northern Labrador are tabulated. Data available from the freshwater exploitation of species other than Atlantic salmon are also included. (Author's abstract)
W87-07031

GENERALIZED STORAGE-RELIABILITY-YIELD RELATIONSHIPS,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W87-07068

INPUT DETECTION BY THE DISCRETE LINEAR CASCADE MODEL,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
A. Szollosi-Nagy.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 353-370, January 1987. 5 fig, 21 ref, append.

Descriptors: *Model studies, *Linear cascade models, *Hydrological forecasting, *Data interpretation, Algorithms, Input values, Case studies, Flood control.

Inverse hydrological forecasting is discussed. As opposed to output prediction from known inputs (and model parameters), the detection of inputs from known outputs (and model parameters) is considered. The model used is the recursive, deterministic, discrete linear cascade model (DLCM) derived from the one-dimensional continuous two-parameter Kalinin-Milyukov-Nash (KMN) cascade set up in linear space. Input detection requires determination of the unsteady initial conditions. This is done via observability analysis. It is shown that the DLCM is observable and the unsteady initial states of the n-dimensional DLCM are uniquely computed from the first n discrete input/output data pairs, the inverse of the observability matrix and the first n DLCM impulse-response ordinates. The initial state vector is used in the recursive deterministic input-detection algorithm. The first n detected input values are necessarily identical with the first n actual inputs. A case study is presented, using the input-detection algorithm to derive operational rules for flood-release basins. (Author's abstract)
W87-07070

BACTERIAL COMMUNITIES IN ACIDIC AND CIRCUMNEUTRAL STREAMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-07078

USE OF A GEOGRAPHIC INFORMATION SYSTEM FOR STORM RUNOFF PREDICTION FROM SMALL URBAN WATERSHEDS,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 7C.
W87-07082

WATERSHED FACTORS AFFECTING STREAM ACIDIFICATION IN THE WHITE MOUNTAINS OF NEW HAMPSHIRE, USA,
IEP, Inc., Northborough, MA.
For primary bibliographic entry see Field 5B.
W87-07084

COLLECTIONS OF THREATENED, ENDANGERED, AND UNIQUE FISH SPECIES IN KANSAS STREAMS: YEAR 1982,
Kansas Fish and Game Commission, Pratt. Environmental Services Section.
For primary bibliographic entry see Field 2H.
W87-07088

DIATOMS FROM STREAMS IN ELLIS AND RUSSELL COUNTIES, KANSAS,
Fort Hays State Univ., Hays, KS. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-07094

EFFECT OF REGIONAL HETEROGENEITY ON FLOOD FREQUENCY ESTIMATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier, J. R. Wallis, and E. F. Wood.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 313-323, February 1987. 8 fig, 1 tab, 27 ref.

Descriptors: *Flood frequency, *Floods, *Regional heterogeneity, *Estimating equations, *Estimates, Mathematical equations, Mathematical studies, Variation coefficient, Statistics, Statistical analysis, Statistical methods.

Recent work on regional flood frequency showed that accurate flood quantile estimates are possible when the underlying flood frequency distributions are identical at all sites in the region except for a scaling factor, particularly when the underlying distribution has a two-parameter form. The class of regional probability-weighted moment (PWM) estimators is investigated for robustness to misspecification of the assumed distributional form and to regional heterogeneity in moments of order higher than one. Whereas two-parameter distributions belonging to the extreme value family perform quite well when the form of the underlying distribution is close to that of the fitted distribution, large biases can result when the distribution is misspecified. The three-parameter generalized extreme value distribution (GEV), when fitted using the regional PWM method, was shown to be relatively insensitive to violations of the distributional assumption, and to have low variability and bias. It is shown that regional estimation methods using the three-parameter GEV distribution are relatively insensitive to modest regional heterogeneity in the coefficient of variation and quite insensitive to regional variation in the skew coefficient. The key determinant of the performance of the regional estimators is shown to be the regional mean coefficient of variation. For high values of the mean coefficient of variation, such as might be encountered in arid regions, an alternate PWM estimation method based on the GEV distribution that accommodates the regional heterogeneity in the higher order moments is preferred. The trade-off between this alternate method and the approach that assumes regional homogeneity in moments higher than order one is sensitive to the record lengths. (Author's abstract)
W87-07111

PORE WATER UPAKE BY AGRICULTURAL RUNOFF,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr, C. Richardson, and D. Baughman.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 1, p 49-63, February 1987. 12 fig, 2 tab, 10 ref.

Descriptors: *Agricultural runoff, *Interstitial water, *Entrainment, *Non-point pollution sources, *Mass transfer, *Model studies, Diffusion coefficient, Mixing, Mathematical analysis, Pesticides, Earth-water interfaces.

The entrainment of soil pore water by overland flow is examined. In a series of laboratory experiments water was passed at various velocities and depths over a soil bed. The soil was saturated with sodium bromide solution prior to each experiment. Runoff water was sampled at the end of the flume and analyzed for bromide concentration. From these data, mass loss rate and cumulative mass loss curves are developed. A Fickian diffusion model is formulated to describe mass transfer from the soil interstices to the overland flow. A procedure to determine the coefficient of diffusion from experimental data is developed and implemented. In general, laboratory results exhibit typical Fickian behavior for large time. The diffusion coefficient varies with velocity, depth of flow, soil surface roughness, and soil condition. Early runoff data, however, exhibit distinct non-Fickian behavior. This research, along with other work, shows that models capable of accurately predicting non-point source pollutant losses for individual runoff events must consider the entrainment mechanisms operative near the soil-water interface for the entire event. The experiments described herein attempt to explore these mechanisms for overland flow only using gross hydraulic and soil parameters. (Airone-PTT)
W87-07121

WATER QUALITY DATA ANALYSIS IN CHUNG KANG RIVER,
Asian Development Bank, Manila (Philippines).
For primary bibliographic entry see Field 5B.
W87-07130

RECURSIVE STATE AND PARAMETER ESTIMATION WITH APPLICATIONS IN WATER RESOURCES,
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 2A.
W87-07145

CHEMICAL COMPOSITION OF THE PALMIET RIVER WATER,
Durban-Westville Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-07151

SOME EFFECTS OF AFFORESTATION ON STREAMFLOW IN THE WESTERN CAPE PROVINCE, SOUTH AFRICA,
Jonkershoek Forest Research Station, Stellenbosch (South Africa).
For primary bibliographic entry see Field 4C.
W87-07152

SEDIMENTOLOGIC AND GEOMORPHIC VARIATIONS IN STORM-GENERATED ALLUVIAL FANS, HOWGILL FELLS, NORTHWEST ENGLAND,
New Mexico Univ., Albuquerque. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W87-07158

COMPUTERIZED DATA BASE FOR FLOOD PREDICTION MODELING,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
J. M. Hill, V. P. Singh, and H. Aminian.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 21-27, February 1987. 6 fig, 3 tab, 19 ref.

Descriptors: *Information systems, *Data requirements, *Hydrologic models, *Model studies, *Runoff, *Flood forecasting, *Computers, Basins, Drainage, Land use, Hydrographs, Hydrology.

A computerized geographic information system (GIS) was created in support of data requirements by a hydrologic model designed to predict the runoff hydrograph from ungaged basins. Some geomorphologic characteristics (i.e., channel lengths) were manually measured from topographic maps, while other parameters such as drainage area and number of channels of a specified order, land use, and soil type were digitized and manipulated through use of the GIS. The model required the generation of an integrated Soil Conservation Service (SCS) curve number for the entire basin. To this end, soil associations and land use (generated from analysis of Landsat satellite data) were merged in the GIS to acquire a map representing SCS runoff curve numbers. The volume of runoff obtained from the Watershed Hydrology Simulation (WAHS) Model using this map was compared to the volume computed by hydrograph separation and found to be accurate within 19 percent error. To quantify the effect of changing land use on basin hydrology, the GIS was used to vary percentages from the drainage area from forest to bare soil. By changing the basin runoff curve numbers, significant changes in peak discharge were noted; however, the time to peak discharge remained essentially independent of change in area of land use. The GIS capability eliminated many of the change in area of land use. The GIS capability eliminated many of the more traditional manual phases of data input and manipulation, thereby allowing researchers to concentrate on the development and calibration of the model and the interpretation of presumably more accurate results. (Author's abstract)
W87-07177

CLIMATIC VARIATION AND SURFACE WATER RESOURCES IN THE GREAT BASIN REGION,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
I. Flaschka, C. W. Stockton, and W. R. Boggess.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 47-57, February 1987. 3 fig, 6 tab, 33 ref. NSF Grants ATM 79-24365, ATM-8217951 and ATM-8217951.

Descriptors: *Rainfall-runoff relationships, *Climatic effects, *Runoff, *Air pollution effects, *Rainfall, *Great Basin Region, *Hydrologic budget, *Model studies, Basins, Watersheds, Climates, Water demand.

There is mounting evidence that increasing amounts of atmospheric carbon dioxide may lead to significant changes in global climate during the next century. The possible effects of such climatic changes on surface runoff in the Great Basin Region of the western United States was investigated by applying water balance models to four watersheds in Nevada and Utah. The most probable change, a 2 C increase in average annual temperature coupled with a 10 percent decrease in precipitation, would reduce runoff from 17 to 28 percent of the present mean, with drier basins showing the greatest change. Decreasing precipitation by 25 percent causes runoff reductions of 33 to 51 percent. Equivalent changes to a cooler and wetter climate show corresponding increases in runoff of approximately the same magnitude, but such a shift is not considered likely. Based on projected water requirements for the year 2000, a change to a warmer and drier climate would cause severe water shortages in many parts of the Great Basin. (Author's abstract)
W87-07180

ESTIMATING PARAMETERS OF EV1 DISTRIBUTION FOR FLOOD FREQUENCY ANALYSIS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
D. Jain, and V. P. Singh.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 59-71, February 1987. 3 fig, 6 tab, 38 ref, 2 append.

Descriptors: *Flood frequency, *Statistics, *Probability, *Model studies, Estimating, Prediction, Comparison studies, Comparison studies, Data collections, Floods.

The parameters of the extreme value type 1 distribution were estimated for 55 annual flood data sets by seven methods. These are the methods of (1) moments, (2) probability weighted moments, (3) mixed moments, (4) maximum likelihood estimation, (5) incomplete means, (6) principle of maximum entropy, and (7) least squares. The method of maximum likelihood estimation was found to be the best and the method of incomplete means the worst. The differences between the methods of principle of maximum entropy, probability weighted moments, moments, and least squares were only minor. The difference between these methods and the method of maximum likelihood was not pronounced. (Author's abstract)
W87-07181

APPLICATION OF RORB MODEL TO A CATCHMENT IN SINGAPORE,
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-07183

REGIONAL APPLICATION OF AN APPROXIMATE STREAMFLOW PARTITIONING METHOD,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
A. Shirmohammadi, J. M. Sheridan, and W. G. Knisel.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 103-111, February 1987. 5 fig, 7 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Surface flow, *Streamflow, *Rainfall, *Regional analysis, Watersheds, Flow, Channeling, Storms.

The approximate streamflow partitioning method which uses daily rainfall and streamflow data was applied in Coastal Plain, Coastal Flatwoods, and Southern Piedmont physiographic regions for estimation of the surface and subsurface flow components of total streamflow. Sizes of the watersheds ranged from 9.6 sq km to 1,030 sq km. Although the streamflow partitioning method was developed and tested on the Coastal Plain physiographic region, results indicate that the procedure can be applied to other physiographic regions where available data are limited to daily values. The effect of channelization on the partitioned flow components in the Coastal Plain and Coastal Flatwoods physiographic areas was also examined. While channelization was found to decrease the storm-time base, it had no significant effect on the relative percentages of the partitioned flow components. (Author's abstract)
W87-07185

SOME TECHNIQUES FOR USING FREQUENCY ANALYSIS AND REALTIME DATA TO INTERPRET FLOOD POTENTIAL DATA,
Boise National Forest, ID.
J. P. Potyondy.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 139-145, February 1987. 6 fig, 2 tab, 13 ref.

Descriptors: *Data interpretation, *Flood forecasting, *Flood frequency, *Probabilistic process, Peak flow, Prediction, Snow, Streamflow, Utah, Risk assessment, Mathematical studies.

Flood potential data can be effectively interpreted if simple frequency analysis concepts are used to explain the significance of flood potential. Instead of simply presenting data as a quantitative amount or as a percentage of the average condition, predictions can be discussed in terms of their probabilities of exceedance, or return periods. Criteria are presented for evaluating the significance of various return periods. Frequency interpretations are applied to snow course data, peak flow forecasts, and streamflow volume forecasts in northern Utah to illustrate these concepts. In addition, access to realtime data allows tracking of snowmelt progression and identification of any deviations from the forecast flood potential situation. Several data elements, including snowpack, streamflow volume and peak, and realtime data are jointly evaluated to assess potential hazard and probable risk. (Author's abstract)
W87-07190

BRASS MODEL: APPLICATION TO SAVANNAH RIVER SYSTEM RESERVOIRS,
Law Environmental Services, Marietta, GA.
R. Colon, and G. F. McMahon.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 177-190, March 1987. 8 fig, 13 ref. Army COE Contract DACW21-83-D-0020.

Descriptors: *Savannah River, *Reservoirs, *BRASS model, *Model studies, *Flood forecasting, *Streamflow forecasting, *Basin runoff, *Streamflow, *Simulation, Floods, Runoff, Basins, Calibrations, Flood management, Hydrology.

The BRASS (basin runoff and streamflow simulation) model was developed to improve the realtime and predictive determination of flood discharges and stages, and to aid in flood management decisions within the Savannah River system. BRASS is an interactive hydrologic/hydraulic model that combines aspects of continuous and event hydrologic simulation with dynamic streamflow routing, and represents a significant step in the evolution of flood forecasting and flood management techniques. Model datasets were developed for the three major multipurpose reservoirs in the Savannah River system. Practical considerations in development, calibration, verification, and application are discussed. Standard flood management procedures are compared to BRASS results, indicating a potential for improvement in the use of flood control storage, as well as the inaccuracy of hydrologic routing methods. In addition to realtime water control management, the model was successfully used in the analysis of flooding in coastal areas, spillway design and design flood operations for dams, emergency operations for dam failures, and the design of channel modifications for flood control. (Author's abstract)
W87-07193

FLOODWAY DELINEATION AND MANAGEMENT,
Department of Housing and Urban Development, Washington, DC.
For primary bibliographic entry see Field 6F.
W87-07197

PRIORITIZING FLOOD CONTROL PLANNING NEEDS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
D. R. Horn.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 283-292, March 1987. 2 fig, 3 tab, 6 ref.

Descriptors: *Data processing, *Flood control, *Flood protection, *Basins, *Data collections, *Planning, Computers, New Jersey, Priorities, Evaluation.

An approach to establishing priorities for future flood control planning was developed and applied to hydrologic subbasins in New Jersey. Data on historical flood losses, flood potential, and current and prior flood control planning efforts were compiled and entered into a flood control data base, accessed through a computer data base management system. The selection of indicator variables, characterizing flood control planning needs, is considered, along with a system of ranking and weighting these variables for assignment of planning priority numbers to the subbasins. This approach is concluded to provide an adequate screening mechanism for establishing an initial list of planning candidates, although more subjective factors must then be used for further evaluation. (Author's abstract)
W87-07201

CHANNEL ROUTING,
National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
D. L. Fread.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 437-503, 12 fig, 1 tab, 109 ref.

Descriptors: *Routing, *Streamflow forecasting, *Flood routing, *Model studies, *Channel routing, *Mathematical models, *Hydrologic models, Canals, Rivers, Surface flow, Runoff.

Channel routing is a mathematical method (model) to predict the changing magnitude, speed, and shape of a flood wave as it propagates through waterways such as canals, rivers, reservoirs, or estuaries. The flood wave can emanate from precipitation runoff (rainfall or snowmelt), reservoir releases (spillway flows or dam-failures), and tides (astronomical and/or wind-generated). Presented is an overview of the various types of one-dimensional channel routing models. Then a detailed description is given of a particular routing model (FLDWAV) which is representative of the current state of the art. This model has wide applicability and feasible computational requirements, and it is popular with many hydrologists and engineers. It also serves as a framework in which many flood routing complexities can be described and solution techniques presented. Selected applications of the model are presented. Finally, some suggestions are offered concerning future requirements and directions in channel routing development. All mathematical notation used herein is defined when first presented. (See also W87-07346) (Lantz-PTT)
W87-07360

TRANSVERSE MIXING IN MEANDERING LABORATORY CHANNELS WITH RECTANGULAR AND NATURALLY VARYING CROSS SECTIONS,
Texas Univ. at Austin. Center for Research in Water Resources.
C. W. Almquist, and E. R. Holley.
Center for Research in Water Resources Technical Report-205, September 1985. 223 p, 71 fig, 9 tab, 58 ref, append. NSF Grant CME 7923183.

Descriptors: *Hydrodynamics, *Mathematical equations, *Path of pollutants, *Transverse mixing, *Meanders, *Channel flow, *Hydraulic profiles, *Mixing, Flow profiles, Flow pattern, Mathematical analysis, Channels, Advection, Circulation.

Transverse mixing of effluents in meandering open channel flows was investigated in two large meandering laboratory channels. The bulk hydraulics of the two channels were nearly identical, with one channel having a prismatic, rectangular cross section, and the other a varying bed topography similar to that found in typical natural streams. Previous studies on transverse mixing in open-channel flow have all assumed a gradient transport model in the analysis of data. No such assumption is made a priori in this study. The depth-integrated governing mass transport equation was derived retaining the separate effects of net lateral advection, secondary circulation and fluid turbulence, and the corresponding second moment equation was also used in the analysis. In the laboratory experiments, detailed measurements of the mean hydraulics and flow distributions were made through two bends of the channels, including direct measurement of the helical secondary flow in the bends. Continuous injections of a saline tracer solution were made at several locations, and the resulting concentration distributions were measured using a system which allowed simultaneous multiple point measurements with no inter-probe interference, no balancing of bridges and no requirement for calibration of the individual probes. The analysis of the experimental data was based directly on the governing differential and moment equations, with the rate of lateral transport due to advection, secondary circulation and turbulence being evaluated separately. Both turbulence and secondary circulation was maximum in the last one-third of a bend and minimum near the entrance of a bend. Nevertheless, certain features of the turbulent transport can be identified. The rate of turbulent lateral mixing was also found to depend strongly on position in a bend, with maximum transport rates of up to five times that expected in a hydraulically similar straight channel, and minimum transport rates of essentially zero. The magnitude of the turbulent transport was related to the strength of the secondary flow. The non-uniform cross-sectional geometry of the natural channel had the greatest influence on lateral mixing when the tracer plume was confined to the half of the channel nearest the inside bank in a bend, where relatively high rates of turbulent transport were observed. (Author's abstract)
W87-07420

TEST OF A NON-UNIFORM MIXING MODEL FOR TRANSFER OF HERBICIDES TO SURFACE RUNOFF,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W87-07450

REFORESTATION AND THE REDUCTION OF WATER YIELD ON THE SOUTHERN PIEDMONT SINCE CIRCA 1940,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 4C.
W87-07473

INFLUENCE OF ANTECEDENT CATCHMENT CONDITIONS ON SEASONAL FLOOD RISK,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
T. M. Ettrick, J. A. Mawdlsey, and A. V. Metcalfe.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 481-488, March 1987. 4 fig, 2 tab, 18 ref, append.

Descriptors: *Model studies, *River flow, *Catchments, *Flood risk, *Runoff forecasting, *Flood forecasting, Rainfall, Flow, England, Rivers, Base flow, Probabilistic process.

A model is proposed which estimates the probability of the flow in a river exceeding a given discharge during a period of 1 month conditional on the catchment wetness at the start of the month. The model is fitted to data selected on the basis of a rainfall threshold. It assumes a Weibull distribution of flows conditional on rainfall and catchment wetness. The model is applied to the River Browney and the River Aire in the north of England. Base flow in the river is used as a measure of catchment wetness. Extreme value distributions are fitted to the rainfall and base flow data independently, and a Poisson distribution is assumed for the number of exceedances above the rainfall threshold in each month. The results from these catchments show that the antecedent catchment conditions significantly affect the flood risk. (Author's abstract)
W87-07477

SOME SPACE-FILLING CONTROLS ON THE ARRANGEMENT OF TRIBUTARIES IN DENDRITIC CHANNEL NETWORKS,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams, and J. Updegraph.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 489-495, March 1987. 8 fig, 3 tab, 13 ref.

Descriptors: *Hydrodynamics, *Streamflow, *Channel networks, *Tributaries, *Geomorphology, *Channel morphology, *Spatial variation, Subbasins, Streams.

The arrangement of tributaries in dendritic channel networks is controlled in part by the relationship between the spatial requirements of the tributaries and the availability of space. An investigation of 6105 tributaries in four dendritic networks reveals that the arrangement of tributaries of different sizes along subbasin main streams is influenced by two constraints on the availability of space on the acute side (inside) of the main streams. The first constraint arises from the tendency for semidivide angles (between the main stream and adjacent divides) at subbasin outlets to be larger on the obtuse (outside) than on the acute side of the main stream. This constraint not only causes a higher proportion of large tributaries than small ones to form on the obtuse side of subbasin main streams near their outlets but favors the development of large tributaries on the obtuse side farther upstream than small ones. The second constraint is imposed by the tendency for subbasin main streams to curve upstream. This constraint affects tributaries that are almost as large as the subbasin main stream they join and, like the first constraint, it favors the formation of large tributaries on the obtuse side farther upstream than small ones. (Author's abstract)
W87-07478

SOME DYNAMIC ASPECTS OF RIVER GEOMETRY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
B. Yu, and M. G. Wolman.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 501-509, March 1987. 9 fig, 25 ref, append.

Descriptors: *Hydrodynamics, *Model studies, *Alluvial rivers, *Streamflow, *Channel morphology, *Geomorphology, *River geometry, *Channels, Missouri River, Simulation, Flow, Prediction, Discharge.

Natural alluvial river channels, in contrast to most regime or equilibrium canals, are characterized by variable streamflows. This paper relates channel geometry to measures of streamflow variability as distinct from mean discharge or flow magnitude. A relationship between mean channel width and the mean and coefficient of variation of channel-forming discharges is derived. For the given mean discharge it is shown that the more variable the flow, the narrower the channel is in the mean. To a great extent, this relationship is confirmed by data on alluvial channels in the Missouri River basin. Variability of water discharges proves to be an important factor influencing natural river geometry. This initial approach to the understanding of the dynamics of river geometry leads to the construction of a simple simulation model in which a series of channel forming discharges is generated and corresponding changing channel geometry is calculated. Results from the simulation indicate (1) the channel has, in effect, a kind of truncated memory; i.e., the impact of an existing channel exists so long as the prevailing discharge does not exceed the present channel capacity; (2) the effect of memory or the impact of the existing channel on the mean channel geometry is opposite to that of flow variability (i.e., the memory tends to keep the channel geometry larger in the mean); (3) the simulated channel width, as expected, increases abruptly at high discharges, declining over time along a die-away curve until the advent of a recorded high flow. (Author's abstract)
W87-07480

USE OF CONTRASTING D/H RATIOS OF SNOWS AND GROUNDWATERS OF EASTERN NEW YORK STATE IN WATERSHED EVALUATION,
Houston Univ., TX. Dept. of Geological Sciences.
J. R. Lawrence.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 519-521, March 1987. 2 fig, 1 tab, 9 ref.
NSF Grants ATM-85-41987 and ATM-77-19217.

Descriptors: *Runoff, *Snowmelt, *Isotope studies, *Deuterium, *Hydrogen, *Tracers, *Rainfall-runoff relationships, *Groundwater, *Watersheds, New York, Snow, Percolation, Exfiltration.

The D/H ratios of snow on the ground and groundwaters in eastern New York State in early spring differ by 5.0% (delta notation). This is large in comparison to the analytical precision of + or - .1% and permits estimation of the input of snowmelt directly to runoff versus groundwater input to runoff resulting from increased hydraulic head as the snow melts and percolates into the ground. In 1978 the high overflow resulting from snowmelt contained only 25% meltwater; the rest was provided by an increased groundwater exfiltration. (Author's abstract)
W87-07483

SEASONAL VARIATION IN THE ABUNDANCE AND HETEROTROPHIC ACTIVITY OF SUSPENDED BACTERIA IN TWO LOWLAND RIVERS,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 2H.
W87-07485

SPAWNING PERIODICITY OF THE ASIATIC CLAM CORBICULA FLUMINEA IN THE NEW RIVER, VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-07518

EFFECTS OF THERMAL REGIME ON SIZE, GROWTH RATES AND EMERGENCE OF TWO SPECIES OF STONEFLIES (PLECOPTERA: TAENIOPTERYGIDAE, PTERONARCYIDAE) IN THE FLATHEAD RIVER, MONTANA,
Montana Univ., Bigfork. Biological Station.
For primary bibliographic entry see Field 2H.
W87-07519

CALCULATION OF FLOW AND POLLUTANT DISPERSION IN MEANDERING CHANNELS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 5B.
W87-07548

AGRICULTURAL CHEMICALS AND HEAVY METALS IN UPLAND SOILS AND VALLEY ALLUVIUMS OF THE LITTLE WASHITA RIVER BASIN,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W87-07562

2F. Groundwater

NUMERICAL SIMULATION OF THE CONVECTIVE TRANSPORT OF A NONINTERACTIVE CHEMICAL THROUGH AN UNSATURATED/SATURATED POROUS MEDIA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W87-06651

SIMULATION OF SALTWATER INTRUSION IN VOLUSIA COUNTY, FLORIDA,
GeoTrans, Inc., Herndon, VA.
J. W. Mercer, B. H. Lester, S. D. Thomas, and R. L. Bartel.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 951-965, December 1986. 12 fig, 2 tab, 9 ref.

Descriptors: *Model studies, *Computer models, *Saline water intrusion, *Simulation, *Volusia County, *Aquifers, *Groundwater, Water resources management, Florida, Water demand, Wells, Discharge, Calibrations, Recharge.

Volusia County, in east central Florida, comprises approximately 1,200 square miles situated between the St. Johns River and the Atlantic Ocean. Most of the County is underlain by a three-aquifer system. Population centers in Volusia County, which create a large water demand, are located near the coast. Saltwater intrusion into the ground water near these population centers has led to relocation of public water supply wells further inland. Regional management of the country's water resources commissioned construction of a three-dimensional computer model of the county. Predevelopment simulation results were used as initial conditions for the development simulations, which included well discharge data. The predevelopment model calibration consisted of reproducing field-determined potentio-metric surfaces. As part of the calibration process, sensitivity analyses were performed on boundary conditions, recharge rates, permeability, and leakage properties. Results of the model study indicate the utility of computer models as a management tool for the complex ground-water system in Volusia County. (Author's abstract)
W87-06688

MISSISSIPPI EMBAYMENT AQUIFER SYSTEM IN MISSISSIPPI: GEOHYDROLOGIC DATA COMPILATION FOR FLOW MODEL SIMULATION,
Geological Survey, Jackson, MS. Water Resources Div.
J. K. Arthur, and R. E. Taylor.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 1021-1029, December 1986. 11 fig, 3 ref.

Descriptors: *Computer models, *GC RASA study, *Aquifers, *Geohydrology, *Flow models, *Simulation, *Model studies, *Mississippi, Data

collections, Well logs, Computer programs, Data storage, Mapping, Data processing.

As part of the Gulf Coast Regional Aquifer System Analysis (GC RASA) study, data from 184 geophysical well logs were used to define the geohydrologic framework of the Mississippi embayment aquifer system in Mississippi for flow model simulation. Five major aquifers of Eocene and Paleocene age were defined within this aquifer system in Mississippi. A computer data storage system was established to assimilate the information obtained from the geophysical logs. Computer programs were developed to manipulate the data to construct geologic sections and structure maps. Data from the storage system will be input to a five-layer, three-dimensional, finite-difference digital computer model that is used to simulate the flow dynamics in the five major aquifers of the Mississippi embayment aquifer system. (Author's abstract)
W87-06694

EFFICIENT AQUIFER SIMULATION IN COMPLEX SYSTEMS,
Universidad Politecnica de Valencia (Spain).
J. Andreu, and A. Sahuquillo.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 110-129, January 1987. 5 fig, 1 tab, 28 ref, 1 append.

Descriptors: *Groundwater movement, *Model studies, *Subsurface, *Aquifers, *Simulation analysis, Piezometric head, Vectors, Spain.

A methodology is presented for including the subsurface flow in water resource simulation models, when linearity can be accepted, using the eigenvalues numerical technique. If the eigenvalues technique is used to solve groundwater linear flow equations, the eigenvectors provide an orthonormal basis. In this basis a state vector for the aquifer can be explicitly and efficiently computed. From this vector variables of interest (piezometric heads or fluxes) in some or all points of the aquifer can be obtained in the time desired. Also, in most real cases, external actions can be expressed as a linear combination of a reduced set of basic stresses, allowing there to be an important reduction in computations. The number of operations used for previous computations and for each time period are evaluated for this approach and for others currently being used. The proposed approach is more convenient when the simulations to be performed for various alternatives are of considerable accumulative length. The approach is used as the groundwater flow module in a simulation module of a conjunctive use scheme in eastern Spain. (Authors' abstract)
W87-06714

NITRATE LEACHING AND DRAINAGE FROM ANNUAL AND PERENNIAL CROPS IN TILE-DRAINED PLOTS AND LYSIMETERS,
Sveriges Lantbruksuniversitet, Umea.
For primary bibliographic entry see Field 5B.
W87-06719

NITRATE LEACHING LOSSES FROM MONOLITH LYSIMETERS AS INFLUENCED BY NITRAPYRIN,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5B.
W87-06723

PROTECTION OF WATERLINES TRAVERSING A HAZARDOUS WASTE LANDFILL,
Toledo Public Utilities Dept., OH.
For primary bibliographic entry see Field 5G.
W87-06774

WATER SEEPAGE THROUGH MULTILAYERED ANISOTROPIC HILLSIDE,
Louisiana Agricultural Experiment Station, Baton Rouge.
For primary bibliographic entry see Field 2G.
W87-06792

INVERSE PROBLEM FOR CONFINED AQUIFER FLOW: IDENTIFICATION AND ESTIMATION WITH EXTENSIONS,
Wright State Univ., Dayton, OH. Dept. of Geology.
H. A. Loaiciga, and M. A. Marino.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 92-104, January 1987. 1 fig, 5 tab, 35 ref, 2 append. Water Resource Center Project UCAL-WRC-W-634.

Descriptors: *Confined aquifers, *Least squares method, *Flow equations, *Groundwater movement, *Model studies, *Estimating, Statistics, Prediction, Simulation, Comparison studies, Evaluation.

A methodology for estimating the elements of parameter matrices in the governing equation of flow in a confined aquifer was developed. The estimation techniques for the distributed-parameter inverse problem pertain to linear least squares and generalized least squares methods. The linear relationship among the known heads and unknown parameters of the flow equation provides the background for developing criteria determining the identifiability status of unknown parameters. Under conditions of exact or overidentification it is possible to develop statistically consistent parameter estimators and their asymptotic distributions. The estimation techniques, namely, two-stage least squares and three stage least squares, were applied to a specific groundwater inverse problem and compared between themselves and with an ordinary least squares estimator. The three-stage estimator provided the closer approximation to the actual parameter values, but it also showed relatively large standard errors compared to the ordinary two-stage estimators. The estimation techniques provide the parameter matrices required to simulate the unsteady groundwater flow equation. A nonlinear maximum likelihood estimation approach to the inverse problem is presented. The statistical properties of maximum likelihood estimators were derived, and a procedure developed to construct confidence intervals and do hypothesis testing. The relative merits of the linear and maximum likelihood estimators are analyzed. Other topics relevant to the identification and estimation methodologies, i.e., a continuous-time solution to the flow equation, coping with noise-corrupted head measurements, and extension of the developed theory to nonlinear cases are also discussed. A simulation study was used to evaluate the methods developed in this study. (Author's abstract)
W87-06820

GROUNDWATER CONTAMINATION AND RECLAMATION,
American Water Resources Association, Bethesda, MD.
Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. 175 p. Edited by Kennith D. Schmidt.

Descriptors: *Groundwater pollution, *Path of pollutants, *Fate of pollutants, *Water pollution treatment, *Symposium, Water quality control, Monitoring, Legal aspects.

The American Water Resources Association (AWRA) believes in communication among the various people in water resource issues. The AWRA Symposium is an opportunity to share experiences, to debate issues, and to understand the views of other on specific topics. This series of papers is organized into four topics: (1) groundwater monitoring, (2) legal and political issues, (3) groundwater protection, and (4) groundwater reclamation. Both generic, or regional, and site-specific studies are discussed, and together these papers cover many parts of the United States. Both problems and solutions are discussed, and a variety of approaches are presented. (See also W87-06850 thru W87-06870) (Lantz-PTT)
W87-06850

STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM: GROUND WATER RESEARCH,
Geological Survey, Reston, VA. Office of Water Data Coordination.
For primary bibliographic entry see Field 5B.
W87-06852

FENCE LAKE COAL PROJECT, GROUNDWATER MONITORING,
Dames and Moore, Phoenix, AZ.
For primary bibliographic entry see Field 5B.
W87-06853

RMA SOUTHERN TIER CONTAMINATION SURVEY,
Dames and Moore, Bethesda, MD.
For primary bibliographic entry see Field 5B.
W87-06854

REGIONAL GROUND-WATER-QUALITY NETWORK DESIGN,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W87-06855

GROUND WATER POLLUTION INVESTIGATION TECHNIQUES, TUCSON, ARIZONA: A REVIEW OF RECENT PROJECTS IN THE VICINITY OF THE TUCSON INTERNATIONAL AIRPORT,
Tucson Water Dept., AZ.
For primary bibliographic entry see Field 5B.
W87-06856

USING CANCER RISK ASSESSMENTS TO DETERMINE 'HOW CLEAN IS CLEAN',
Twitty, Sievwright and Mills, Phoenix, AZ.
For primary bibliographic entry see Field 5G.
W87-06859

CITY/SUBURB VIEWS ON GROUNDWATER ISSUES,
Appalachian State Univ., Boone, NC. Dept. of Political Science.
For primary bibliographic entry see Field 5G.
W87-06860

POLITICS OF GROUND WATER PROTECTION,
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-06861

BISCAYNE AQUIFER PROTECTION PLAN,
CH2M Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W87-06862

GROUNDWATER PROTECTION BY SOIL MODIFICATION,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5G.
W87-06863

INTERAGENCY STUDY OF OILFIELD BRINE POLLUTION IN KANSAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5B.
W87-06864

PREVENTING VIRAL CONTAMINATION OF DRINKING WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W87-06865

RAPID REMOVAL OF A GROUNDWATER CONTAMINANT PLUME,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5G.
W87-06866

STRATIGRAPHIC INFLUENCE ON CLEAN-UP METHODS: A CASE HISTORY,
Dames and Moore, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W87-06867

NEUTRALIZATION OF ACIDIC GROUND WATER NEAR GLOBE, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 5G.
W87-06868

AQUIFER RESTORATION: IN SITU TREATMENT AND REMOVAL OF ORGANIC AND INORGANIC COMPOUNDS,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 5G.
W87-06869

SHALLOW-AQUIFER DEWATERING FOR SOURCE-AREA CONTROL,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 5G.
W87-06870

COMPARISON OF ANALYTICAL METHODS FOR PHENOLS, CYANIDE, AND SULFATE AS APPLIED TO GROUNDWATER SAMPLES FROM UNDERGROUND COAL GASIFICATION SITES,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5A.
W87-06886

SOME FACTORS CONTRIBUTING TO DECREASED WELL EFFICIENCY DURING FLUID INJECTION,
Woodward-Clyde Consultants, Denver, CO.
For primary bibliographic entry see Field 3E.
W87-06895

INFLUENCE OF FORMATION CLAYS ON THE FLOW OF AQUEOUS FLUIDS,
Haliburton Services, Duncan, OK.
For primary bibliographic entry see Field 2G.
W87-06897

ASSESSMENT OF TRACE GROUND WATER CONTAMINANTS RELEASE FROM SOUTH TEXAS IN-SITU URANIUM SOLUTION MINING SITES,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06940

POTENTIAL USE OF GPR IN ASSESSING GROUNDWATER POLLUTION IN PARTIALLY AND FULLY SATURATED SOILS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W87-06959

CASE HISTORY STUDY OF WATER FLOW THROUGH UNSATURATED SOIL,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W87-06962

GEOLOGIC CHARACTER OF TUFFS IN THE UNSATURATED ZONE AT YUCCA MOUNTAIN, SOUTHERN NEVADA,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2G.
W87-06964

WATER BUDGET FOR SRP BURIAL GROUND AREA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5B.
W87-06996

PROPERTIES OF GROUNDWATER,
Kiel Univ. (Germany, F.R.). Dept. of General and Applied Geology.
G. Matthess.
John Wiley and Sons, New York, New York. 1982. 406 p. Translated by John C. Harvey.

Descriptors: *Groundwater, *Physical properties, *Chemical properties, *Biologic properties, *Hydrologic properties, Aquifers, Groundwater movement, Groundwater recharge.

This book introduces fundamental principles that describe the geochemical mechanisms that control the properties of groundwater, the occurrence of the various dissolved substances, and their natural variations present in groundwater. The relationship between these components and groundwater is described. The physical, chemical, biological, and hygienic properties of groundwater determine its usefulness for human purposes, namely agriculture, industry, and domestic use. Furthermore, groundwater properties give important indications of the nature of aquifers, and supply valuable information about the origin, flow velocity, and direction of groundwater. Modern geochemical prospecting techniques in which substances are carried by groundwater are used for detecting concealed mineral ores and deposits of oil and natural gas. Spas use groundwater in which unusual dissolved mineral matter makes it of therapeutic value to the sick. A high concentration of elements important to agriculture - potassium, bromine, iodine, and others - can be considered to be useful. Water quality is subject to much spatial, and sometimes also periodic variations, the causes of which can very often be discovered only with difficulty, particularly because the chemistry of water itself can be very complex. Many of the physical and chemical principles have been known for a long time, but the rapid increase in the water and the development of geochemistry generally, as well as the application of analytical techniques in recent years, have made possible rapid progress in furthering knowledge of groundwater chemistry. (Lantz-PTT)
W87-06998

NEAR-SURFACE GROUNDWATER RESPONSES TO INJECTION OF GEOTHERMAL WASTES,
Idaho Water and Energy Resources Research Inst., Moscow.
For primary bibliographic entry see Field 5E.
W87-07011

TECHNICAL SUMMARY OF THE A/M AREA GROUNDWATER (AMGW) REMEDIAL ACTION PROGRAM,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5G.
W87-07013

GROUNDWATER MODEL PARAMETER ESTIMATION USING A STOCHASTIC-CONVECTIVE APPROACH,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W87-07015

SRP GROUNDWATER PROTECTION IMPLEMENTATION PLAN, (DRAFT),
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5G.
W87-07025

INTERPRETATION OF THE CONVERGENT-FLOW TRACER TESTS CONDUCTED IN THE CULEBRA DOLOMITE AT THE H-3 AND H-4 HYDROPADS AT THE WASTE ISOLATION PILOT PLANT (WIPP) SITE,
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W87-07029

ANALYSIS OF SALTWATER UPCONING BENEATH A PUMPING WELL,
Geological Survey, Reston, VA.
T. E. Reilly, and A. S. Goodman.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 169-204, January 1987. 14 fig, 7 tab, 26 ref.

Descriptors: *Saline water, *Saline-freshwater interfaces, *Upconing, *Saline water intrusion, *Aquifers, *Groundwater, *Pump wells, Simulation, Solute transport, Numerical analysis, Wells, Dispersivity.

Aquifer systems that contain freshwater and saltwater are usually stratified, with the more dense saltwater underlying the freshwater. A groundwater well discharging from the freshwater zone causes the saltwater to move upwards towards the well. This phenomenon is known as saltwater upconing. Two methods of analysis, the sharp-interface method and the fluid-density-dependent solute-transport method, are used to simulate saltwater upconing. Numerical experiments including comparisons of the two methods indicate: (1) for low to moderate pumpages the 50% isochlor and sharp interface correlate well; (2) the well can discharge significant concentrations of saltwater, even though a stable cone (according to the sharp-interface method) exists below the well screen; (3) an almost linear relationship exists between the well discharge rate and the concentration of the discharge at low pumping rates that maintain a stable cone; and (4) upconing is sensitive to transverse dispersivity, whereas it is insensitive to longitudinal dispersivity. A simulation of upconing at Test Site No. 4, Truro, Cape Cod, Massachusetts, indicates that the appropriate field value of transverse dispersivity is very small. This supports the validity of the sharp-interface assumption for analyzing the behavior of systems with thin saltwater-freshwater transition zones. (Author's abstract)
W87-07063

HYDROGEOLOGY OF COMPLEX LENS CONDITIONS IN QATAR,
Birmingham Univ. (England). Hydrogeology Section.
J. W. Lloyd, J. G. Pike, B. L. Eccleston, and T. R. E. Chidley.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 239-258, January 1987. 8 fig, 5 tab, 9 ref.

Descriptors: *Groundwater lens, *Aquifers, *Groundwater, *Qatar, *Saline-freshwater interfaces, *Groundwater recharge, Runoff, Rainfall, Permeability, Evaporation, Flow, Geohydrology, Arid zone.

The emirate of Qatar lies on a peninsula extending northward from the mainland of Saudi Arabia into the Arabian Gulf. The peninsula is underlain by sedimentary rocks ranging from late Cretaceous to Holocene age but only two Lower Tertiary units are identified as aquifers. The groundwater distribution in these units is seen to be controlled by facies distributions related to tectonically controlled sedimentation and subsequent dissolution. Dissolution has created permeability, in the Umm er Rhaduma limestones and in the ovedrlying Rus anhydrites. In the latter case the dissolution has lead to extensive surface collapse which has provided a mechanism for recharge from runoff. Despite very low rainfall and high evaporation rates, recharge related to storm runoff has resulted in the establishment of a complex fresh groundwater lens in both aquifer units. The lens is constrained by saline groundwaters which in the lower unit are controlled by heads in eastern Saudi Arabia but in the upper unit by the Arabian Gulf sea level. Groundwater abstraction is shown to be distorting the fresh groundwater lens configuration, and estimates of the resultant flow responses affecting the lens are given. (Author's abstract)

W87-07065

CHEMICAL SIMILARITIES AMONG PHYSICALLY DISTINCT SPRING TYPES IN A KARST TERRAIN,
Kentucky Univ., Lexington. Dept. of Geology.
B. R. Scanlon, and J. Thrailkill.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 259-279, January 1987. 15 fig, 3 tab, 26 ref.

Descriptors: *Springs, *Water chemistry, *Karst aquifers, *Aquifers, *Groundwater recharge, Ions, Runoff, Flow, Conduits, Kentucky, Pennsylvania.

In karst regions where correlations between physical characteristics of springs and temporal variations in spring water chemistry were found, spring water chemistry was used to infer physical attributes of karst systems. Springs were tested in the Inner Bluegrass Karst Region of central Kentucky where previous dye-tracing studies have identified two physically distinct spring types: local high-level springs discharging from shallow flow paths and major low-level springs discharging from a deep integrated conduit system. Representative high-level and major springs were sampled over a 16-month period and analyzed for major dissolved components. Both spring types showed similar variations in temperature, calcium, magnesium, bicarbonate, and hardness. No systematic differences in ionic concentrations or in saturation indices with respect to calcite and dolomite were apparent. Chemical similarities between high-level and major springs during low flow are attributed to recharge of major springs by percolation and by high-level springs and to the occurrence of most chemical reactions near the recharge zone rather than in the deep conduit system. During high discharge, most recharge to the major springs is surface runoff which produces low ionic concentrations. Similarly low ionic concentrations in the high-level springs result from rapid flow through the soil-rock zone and short flow distances. These relationships indicate that spring water chemistry is not only a function of conduit size but also an indicator of recharge type and amount and flow path length. Differing flow path lengths to major and high-level springs counteract the effect of varying conduit size between the two spring types and result in similar ionic concentrations. These data indicate that spring water chemistry cannot be used to predict physical characteristics of karst aquifers in the Inner Bluegrass Region. The physical and chemical attributes of springs in the Inner Bluegrass were compared to those of springs in the Nittany Valley of Pennsylvania. A reported high correlation between physical and chemical characteristics of springs in the Pennsylvania karst system reflects geological and structural controls not present in the Inner Bluegrass Region. (Author's abstract)
W87-07066

MIXING CUP AND THROUGH-THE-WALL MEASUREMENTS IN FIELD-SCALE TRACER TESTS AND THEIR RELATED SCALES OF AVERAGING,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
G. L. Moltyaner.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 281-302, January 1987. 12 fig, 22 ref.

Descriptors: *Tracers, *Field tests, *Sampling devices, *Dispersion, *Path of pollutants, *Aquifers, *Chalk River, *Data processing, *Averaging, Wells, Flow, Model studies, Advection.

Methods and scales of averaging associated with the sampling devices used in field-tracer experiments are critically important in the assessment of dispersive properties of aquifers. The importance is illustrated on the basis of experimental data obtained from two nautral-gradient dispersion tests performed at Chalk River, Ontario. The dispersive properties of the tracer-tests aquifer are characterized at the local scale using measurements from dry-access observation wells and multilevel samplers, and at the tracer-occupied-zone and full-aquifer scales by averaging the observed data. The flow-weighted and depth-weighted averaging procedures are considered. The measured and averaged data are analysed using the classical advection-dispersion model. The results of the analysis demonstrate that the application of the advection-dispersion model at the local scale gives laboratory-obtained magnitudes of the longitudinal dispersivity. The application of the advection-dispersion at the full-aquifer scale results in an order-of-magnitude increase of dispersivity. The analysis also emphasizes the fundamental importance of the concept of flow-weighted concentration and quantifies the difference between flow-weighted and depth-weighted mean concentrations. (Author's abstract)
W87-07067

NUMERICAL ESTIMATION OF EFFECTIVE PERMEABILITY IN SAND-SHALE FORMATIONS,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
A. J. Desbarats.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 273-286, February 1987. 15 fig, 33 ref.

Descriptors: *Groundwater movement, *Subsurface water, *Permeability, *Sand, *Shales, *Numerical analysis, *Sandstones, Storm seepage, Mathematical studies, Mathematical equations, Model studies, Mathematical models, Flow characteristics, Sahara, Comparison studies.

A numerical approach is used to estimate effective permeability in sand-shale formations under steady state uniform flow conditions. Permeability is modeled as a binary, second-order stationary random function taking on two possible values K sub ss and K sub sh in sandstone and shale, respectively. This model is realistic since experience with sandstone reservoirs has shown that randomly dispersed low-permeability shales are the single dominant heterogeneity affecting flow behavior. The cases of both spatially correlated and uncorrelated permeabilities are considered. For the case of spatially correlated permeability, an autocovariance model was fitted to data from the Assakao fluvial sandstone which outcrops in the Tassili region of the central Sahara. The turning bands method was used to simulate the spatially correlated permeabilities of blocks discretizing the flow field. Effective permeability was found to depend on the shale volume fraction, the spatial covariance structure, and the dimensionality of the flow system. Existing analytical methods for estimating effective permeability in a two-phase medium are found to be inaccurate when compared to numerical results or unapplicable to stratified environments. In addition to providing a check of analytical work, the numerical approach is found to be a useful tool for exploring the effects of reservoir heterogeneity on flow behavior in a qualitative sense. (Author's abstract)
W87-07108

SALTWATER INTRUSION IN AQUIFERS: DEVELOPMENT AND TESTING OF A THREE-DIMENSIONAL FINITE ELEMENT MODEL,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W87-07110

PRIORITIZING AREAS FOR STATEWIDE GROUNDWATER MONITORING,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7A.
W87-07195

TWO-DIMENSIONAL GROUNDWATER MODELING WITH MICROCOMPUTERS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
W. P. James, K. Laza, F. Bell, G. Moridis, and K. Kim.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 293-307, March 1987. 7 fig, 1 tab, 5 ref.

Descriptors: *Numerical models, *Groundwater models, *Model studies, *Microcomputers, Aquifers, Groundwater, Numerical analysis, Equations.

Two simple numerical models adopted for microcomputer applications and used to analyze groundwater problems are described. The alternating direction implicit method is an iterative procedure used to model relatively large two-dimensional aquifers on microcomputers. The direct solution model uses a checkerboard numbering pattern of the grid elements to reduce the number of continuity equations and solves the remaining equations simultaneously. The analysis of a water barrier and recovery system for a petroleum products terminal is presented and the computation times for both models are compared using IBM, AT and T, and HP microcomputers. (Author's abstract)
W87-07202

GROUNDWATER CONTAMINATION CONTROL AND TREATMENT, ROCKY MOUNTAIN ARSENAL COLORADO,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5G.
W87-07251

STATISTICAL EVALUATION OF HYDRAULIC CONDUCTIVITY DATA FOR WASTE DISPOSAL SITES,
Neyer, Tiseo and Hindo, Ltd.
For primary bibliographic entry see Field 2G.
W87-07252

GROUNDWATER MONITORING SYSTEMS - ONLY AS GOOD AS THE WEAKEST LINK,
ERM-Midwest, Inc., Columbus, OH.
D. E. Johe.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 105-118, 5 tab, 6 ref.

Descriptors: *Groundwater quality, *Monitoring, Groundwater pollution, Sampling, Sample preparation, Sample preservation, Water quality control, Chemical analysis.

The purpose of this chapter is to make the point that a groundwater monitoring program involves a lot more than just collecting a sample and getting it analyzed. A good monitoring program, one that the users can have confidence in, and know that the conclusions are valid, involves numerous elements (sampling methods, preparation and preservation, shipping, chemical analysis, and quality assurance) which have been described. Emphasis has been placed on those elements that are most often overlooked or slighted. The 'bottom line' is that the professional needs to know and understand all of the elements of a good monitoring program and should never try to shortcut the program. If any element is ignored or downplayed in the interest of saving time or money, it could result in questionable or dubious results. In the long run, this could prove to be very expensive in terms of credibility and cash flow. It is better to do the job right the first time, than to have to redo it at ones own expense. (See also W87-07243) (Lantz-PTT)
W87-07253

PROBLEMS IN ASSESSING ORGANICS CONTAMINATION IN GROUNDWATER,
Geraghty and Miller, Inc.
For primary bibliographic entry see Field 5A.
W87-07254

PRIVATE WELL SAMPLING IN VICINITY OF RE-SOLVE, INC., HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5A.
W87-07255

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY - TACOMA WATER SUPPLY WELLS COMMENCEMENT BAY AREA, TACOMA, WASHINGTON,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5B.
W87-07272

PROGRAM FOR STEAM PURITY MONITORING: 2. RESULTS OF POWER PLANT TESTING,
Westinghouse Research and Development Center, Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07287

REGIONAL AQUIFER-SYSTEM ANALYSIS PROGRAM OF THE U.S. GEOLOGICAL SURVEY: SUMMARY OF PROJECTS, 1978-84.
Geological Survey, Reston, VA. Water Resources Div.
U.S. Geological Survey Circular 1002, 1986. 264 p. Edited by Ren Jen Sun.

Descriptors: *Aquifer systems, *Groundwater, *Water resources development, *Geohydrology, *Groundwater resources, Aquifers, Data collections, Geochemistry.

The Regional Aquifer-System Analysis Program of the U.S. Geological Survey was initiated in 1978 as a result of specifications of the appropriations bill of the 95th Congress, prompted by the 1977 drought. The purpose of this program is to define the regional hydrology and geology and to establish a framework of background information of geology, hydrology, and geochemistry of the Nation's important aquifer systems. This information is critically needed to develop an understanding of groundwater flow systems, and to support better groundwater resources management. As of 1984, investigations of seven regional aquifer systems were completed, nine regional aquifer systems were still being studied, and three new studies were started. This report summarizes the status of each investigation of the regional aquifer systems under the program from 1978 through 1984. The nature of the summaries differs somewhat from study to study. For those studies which either have been completed or are near completion, summaries of results are presented. For projects that are not near completion or have just been started, discussions may be brief and focus on problem issues or hydrogeologic conditions. All reports resulting from the study as of 1984 are listed at the end of each summary. A list of project chiefs and their offices is also included in the report for those who are interested in obtaining additional information. (See also W87-07313 thru W87-07335) (Author's abstract)
W87-07312

CENTRAL VALLEY REGIONAL AQUIFER-SYSTEM STUDY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
G. L. Bertoldi, and R. J. Sen.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 9-16, 8 fig, 8 ref.

Descriptors: *Aquifer systems, *California, *Central Valley, *San Joaquin Valley, *Groundwater resources, *Sacramento Valley, *Groundwater management, *Groundwater movement, *Geohydrology, Geochemistry, Boron, Permeability coefficient, Water resources development, Irrigation.

The Central Valley of California occupies about 12% of the total land area of the State of California. It is a large alluvium-filled structural basin occupying approximately 20,000 sq mi of the flatland lying between the Coastal Ranges and Valleys to the west and Sierra Nevada Range to the east. The aquifer system of the Central Valley is composed of a heterogeneous mixture of continental alluvial materials derived from the surrounding mountains. Thickness of the sediments averages about 2,900 feet in the San Joaquin Valley and 1,500 feet in the Sacramento Valley. Many significant findings have emerged from a Central Valley regional aquifer which may have an application to the general knowledge of groundwater hydrology. Some of these are: (1) discovery of a compressible clay in the Sacramento Valley that is similar to the Corcoran Clay Member of the Tulare Formation, a major confining unit in the San Joaquin Valley; (2) natural geochemical controls and mechanisms were defined for the Sacramento Valley thus establishing baseline information on water quality; (3) areas where groundwater has high concentrations of boron were mapped; (4) estimates of groundwater storage, hydraulic conductivity, porosity, and potential land subsidence in the Sacramento Valley were made on the basis of information resulting from more than 10,000 wells augmented by the seven deep exploratory test wells; (5) prior to development, the aquifers were recharged by precipitation and stream seepage in upland and discharged to streams, lakes or topographic depressions and by evapotranspiration in the central part of the Valley; (6) since development, about 64 million acre-ft of groundwater has been removed from aquifer storage; (7) simulation indicates that during 1961-77, groundwater discharge was about 11.8 million acre-ft/yr, of which 94% was for irrigation, 3% was for municipal water supplies, and 3% discharged to streams, lakes and topographic depressions; (8) the average horizontal hydraulic conductivity of the valley sediments is about 6 ft/d; (9) the average thickness of the continental deposits in the central Valley is about 2,400 ft, and increases from north to south with the maximum thickness of about 9,000 ft near Bakersfield; and (10) groundwater quality has the potential of being degraded by poor quality irrigation return flow. (See also W87-07312) (Lantz-PTT)
W87-07313

FLORIDAN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Atlanta, GA.
P. W. Bush, and R. H. Johnston.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 17-29, 12 fig, 19 ref.

Descriptors: *Aquifer systems, *Florida, *Groundwater resources, *Groundwater movement, *Geohydrology, Water resources development, Geochemistry, Mapping, Computer models, Water analysis, Groundwater management, Hydrologic properties.

The Floridan aquifer system is one of the major sources of groundwater supplies in the United States. This highly productive aquifer system underlies all of Florida, southeastern Georgia, and small parts of adjoining Alabama and South Carolina, for a total area of about 100,000 sq mi. A total of about 3 Bgal/d is withdrawn from the aquifer system, and, in many areas, the Floridan aquifer system is the sole source of freshwater. During 1978-83, the Survey conducted a regional assessment of the Floridan Aquifer system that involved the review and synthesis of many previous studies, the acquisition of new data in selected areas, and the extensive use of computer-based models to simulate the groundwater flow. The approach to studying the Floridan aquifer system was to focus on (and document) local differences while tying together, in a regional analysis, the individual segments of the aquifer system. A series of regional geohydrologic, geochemistry, and potentiometric surface maps was prepared. Eleven of these maps were published during the course of the study. A data collection program was undertaken to fill the data gaps. This work involved a program of exploratory drilling, aquifer tests, seismic surveys (onshore and offshore), selective geochemical sampling, and mass measurement of water levels and artesian pressures. A notable example of these activities was the collection of hydrologic and geochemical data from an abandoned oil exploratory well 55 miles offshore from the east Florida coast. Computer simulation involved the design and calibration of a 'coarse-mesh' regional flow model and four subregional flow models. The goal of the regional flow model was to understand the major features of the flow system. (See also W87-07312) (Lantz-PTT)
W87-07314

HIGH PLAINS REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Denver, CO. Water Resources Div.
J. B. Weeks.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 30-49, 8 fig, 1 tab, 13 ref.

Descriptors: *Aquifer systems, *Groundwater resources, *Geohydrology, *High Plains Aquifer, *Colorado, *Kansas, *Nebraska, *Wyoming, *New Mexico, *Oklahoma, *South Dakota, *Texas, *Groundwater management, Pumping, Water supply, Water levels, Economic aspects, Irrigation.

The High Plains regional aquifer system underlies about 174,000 sq mi in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. The aquifer system is the shallowest and most abundant source of water in one of the major agricultural areas in the United States. About 20% of the irrigated land in the United States is in the High Plains, and about 30% of the groundwater used for irrigation in the United States is pumped from the High Plains aquifer system. In 1980, about 170,000 wells pumped about 18 million acre-ft of water to irrigate nearly 14 million acres. The irrigated-agricultural economy of the High Plains is dependent on the aquifer system for continued growth and prosperity. However, declining water levels and decreasing water supplies threaten the future of irrigation using groundwater in parts of the High Plains. National concern about the economic impact of declining water supplies in the High Plains was responsible for the initiation of a regional study of the High Plains aquifer system in 1978. This regional study was completed in 1982. (See also W87-07312) (Lantz-PTT)
W87-07315

NORTHERN GREAT PLAINS REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Reston, VA. Water Resources Div.
G. A. Dinwiddie, and J. S. Downey.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 50-71, 15 fig, 23 ref.

Descriptors: *Aquifer systems, *Northern Great Plains Aquifers, *Groundwater resources, *Geohydrology, *Groundwater movement, Brines, Glaciation, Vertical flow, Geochemistry, Groundwater management, Drawdown, Pumping.

The study area of the Northern Great Plains regional aquifer system is about 250,000 sq mi and includes North Dakota and parts of South Dakota, Montana, Wyoming, and Nebraska. It is bounded on the west by the central and northern Rocky Mountains, on the east by the Red River of the North, on the south by the central High Plains, and on the north by the United States-Canadian Border. The Northern Great Plains mostly is underlain by sandstone, shale, and some evaporite deposits. The principal aquifers generally crop out along the flanks of the Williston and Powder River basins and along other major structural features. The flow pattern prior to glaciation was presumably similar to that at present, sustained by recharge in highlands to the west. Glaciation produced repeated variation of flow directions, but, in general, the glaciation did not cause major changes in distribution of the brine. The Cambrian-Ordovician aquifer system apparently discharges partly to a number of saline lakes in eastern North Dakota. Geologic evidence and water chemistry suggest that these lakes now function as drains for the regional groundwater flow system. Test drilling indicates that thick deposits of glacial sand and gravel underlie the depressions and are hydraulically connected with the underlying Paleozoic aquifer systems. Vertical leakage through confining units are major contributors to groundwater discharge. Future development of the regional aquifer system in the Northern Great Plains should take into account that part of the water withdrawn from wells may come from storage in the confining unit except where a confining unit is absent or highly fractured. The quality of water from the confining units may be entirely different from the

quality of water from the aquifer systems. Simulated drawdowns in selected aquifers after a hypothetical pumping for 5.9 years at a rate of 27.9 cu ft/s from the Mississippian aquifer system with an assumed uniform storage coefficient of 2,000,000 indicate the degree of hydrologic connection among the aquifer systems. The pumping of the Mississippian aquifer system results in large drawdowns in the overlying Pennsylvanian aquifer system and much larger drawdowns in the underlying Cambrian-Ordovician aquifer system. (See also W87-07312) (Lantz-PTT)
W87-07316

NORTHERN MIDWEST REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Madison, WI. Water Resources Div.
H. L. Young, D. I. Siegel, and, R. J. Mandle, and A. L. Kontis.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 72-87, 12 fig, 13 ref.

Descriptors: *Aquifers, *Cambrian-Ordovician Aquifer, *Groundwater resources, *Illinois, *Indiana, *Iowa, *Minnesota, *Missouri, *Wisconsin, *Geohydrology, *Groundwater movement, Groundwater management, Permeability coefficient, Flow patterns, Water resources development, Water supply.

The Northern Midwest regional aquifer-system study was started in 1978 and completed in 1984. The study was designed to investigate the hydrogeology, groundwater availability, and chemical quality of the groundwater in an aquifer system consisting of rocks of Cambrian and Ordovician age, in parts of Illinois, Indiana, Iowa, Minnesota, Missouri, and Wisconsin, and to describe the regional interaction of all components of the aquifer system. This aquifer system is referred to as the Cambrian-Ordovician aquifer system in this report. The Cambrian-Ordovician aquifer system is a leaky-artesian system; and movement of groundwater is partly controlled by internal confining units of low permeability. Regional groundwater movement in the confined part of the system is generally away from the structural highs in the north toward the structural lows (basins) in the south and east. The rate of groundwater movement is very slow and the flux along flow paths into the basins decreases due to a reduction in permeability and a progressive loss of water from the continuous although small, upward leakage. The Cambrian-Ordovician aquifer system supplies a major part of the water needs in the study area. Many metropolitan areas depend on it for all or part of their water supplies. Hydraulic heads in the aquifer system have declined hundreds of feet since the late 1800's in the heavily pumped Chicago-Milwaukee area and to a somewhat lesser extent in other major metropolitan areas. Projections of future water needs indicate continuing water-level declines are expected. The aquifer system contains highly mineralized water in several places, especially in its deepest parts, which generally coincide with regional discharge areas or structurally low areas. These areas are mainly in the southwestern, southern, and eastern parts of the study area. Water from highly mineralized zones may be induced into freshwater zones by large withdrawals of freshwater, such as those presently occurring in northeastern Illinois, southeastern Wisconsin, and central Iowa. (See also W87-07312) (Lantz-PTT)
W87-07317

SNAKE RIVER PLAIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 88-106, 15 fig, 17 ref.

Descriptors: *Aquifer systems, *Idaho, *Groundwater resources, *Snake River Aquifer, *Groundwater movement, *Geohydrology, Irrigation, Flow patterns, Groundwater management, Groundwater recharge, Model studies, Groundwater quality.

Large quantities of good quality ground and surface water are available on the Snake River Plain, Idaho. For study purposes, the Plain was divided into eastern and western parts. As much as 3,500 ft of saturated Quaternary basalt underlie the eastern Plain. The upper 200 ft have the highest hydraulic conductivity, and estimated transmissivity ranges from 0.05 to 44 sq ft/sec. An estimated 200 to 300 acre-ft of water are stored in the upper 500 ft. The thickness of the basalt aquifer was estimated largely from electrical-resistivity soundings. Interpretations of surface geophysical data were checked by drilling a 1,123-ft test hole. In the western Plain, generally fine-grained Tertiary sedimentary rocks predominate; water in the western Plain is obtained from unconfined alluvial sand and gravel aquifers in the Boise River Valley, from basalt east of Boise, and from confined sand aquifers in other areas. Volcanic rocks underlying the fine-grained sedimentary rocks in the western Plain contain confined thermal water. Prior to irrigation, streamflow and underflow from tributary drainage basins were the major sources of recharge to the Snake River Plain regional aquifer system. In 1980, infiltration of surface water used for irrigation supplied about two-thirds of the recharge in the eastern Plain. Over the years, groundwater levels rose several tens of feet, owing to surface-water irrigation. As water levels rose, groundwater discharge, largely spring flow, increased. Steady-state and transient finite-difference groundwater flow models were developed for the eastern and western Plain. Steady-state models were calibrated to 1980 hydrologic conditions; transient models were calibrated from preirrigation to 1980. The models reasonably simulated current and past hydrologic conditions. Water quality is generally good. Most solutes originate in tributary basins, and concentrations of ions change little as water flows from areas of recharge to areas of discharge. (See also W87-07312) (Lantz-PTT)
W87-07318

STUDY IN PARTS OF COLORADO, NEW MEXICO, AND TEXAS,
Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Wilkins.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 107-115, 5 fig, 9 ref.

Descriptors: *Aquifer systems, *Colorado, *New Mexico, *Texas, *Groundwater resources, *Geohydrology, Precipitation, Groundwater recharge, Groundwater quality, Groundwater movement, Geochemistry, Model studies, Simulation analysis.

The study of aquifer systems underlying the southwest alluvial basins in parts of Colorado, New Mexico, and Texas was started in 1978 and completed in 1984, except for report writing. The study covers a total area of 70,000 sq mi within or adjacent to three physiographic provinces. The northern part of the study area is in the Southern Rocky Mountains Province, the central part is in the Basin and Range Province, and the west-central part is in the Colorado Plateau province. The Great Plains Province is east of the study area. Except for a small area in its southwest corner, the study area is bounded by the Continental Divide on the west. Two types of basins occur in the study area: (1) open basins are within the Rio Grande rift; and (2) closed basins are predominantly in southwest New Mexico and west Texas having no surface water outflow. The Rio Grande rift is a fault-bounded structural feature with uplifted blocks on the east and on the west. Uplifted blocks to the east of the basins generally rise several thousand feet above the valley floor of the basins. Precipitation in the uplifted mountainous blocks east and west of the basins is high and is the source of the surface water which eventually recharges the aquifers near the base of the mountains. Quality of groundwater changes areally and vertically. Groundwater underlying the Rio Grande river from near Espanola to east of Socorro, NM, has concentrations of dissolved solids less than 1,000 mg/L from land surface to a depth of about 2,000 ft. Below this depth, concentrations of dissolved solids are as much as 3,000 mg/L. Concentrations of dissolved solids increase to a range of 3,000 to 10,000 mg/L below about 1,900 ft in the Jornada del Muerto Basin to the south. Geologic studies were initiated early during the study with the objective of selecting representative basins and of characterizing these selected basins. Basin boundaries were delineated on the basis of bedrocks or faults that separated the basins into distinct hydrologic areas. Topographic and surface water divides were also considered. This process resulted in dividing the alluvial basins in the study area into 22 basins. The results of geochemical studies, recharge models, and simulation analyses are also presented. (See also W87-07312) (Lantz-PTT)
W87-07319

STUDY IN SOUTHERN AND CENTRAL ARIZONA AND PARTS OF ADJACENT STATES,
Geological Survey, Tucson, AZ. Water Resources Div.
T. W. Anderson.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 116-131, 11 fig, 7 ref.

Descriptors: *Aquifer systems, *California, *Nevada, *New Mexico, *Colorado River, *Groundwater resources, *Geohydrology, *Groundwater recharge, *Groundwater movement, Alluvial basins, Alluvial deposits, Model studies, Simulation analysis.

The study of the alluvial basin regional aquifer systems in southern and central Arizona and parts of California, Nevada, and New Mexico covering an area of about 82,000 sq mi was started in 1978. All activities were completed in 1984, except for report writing. The study area is composed of 72 alluvial basins. The basins are filled with alluvial deposits that range from a few thousand feet to more than 10,000 ft in thickness. In almost all basins, the general vertical sequence of sedimentary units is, in ascending order, sediments deposited before the formation of the Basin and Range topography, lower and upper basin fill, and stream alluvium. Each of hydrogeologic units has different physical, geologic, and hydrologic properties largely because of differences in the depositional environment and source area of the sedimentary material. An estimated 900 million acre-ft of recoverable water was stored in the upper 1,200 ft of the sediments before development. The amount of water entering and leaving the basin aquifers is estimated to be about 2.5 million acre-ft/yr. From the beginning of development through 1980, an estimated 184 million acre-ft of water has been pumped. Although a part of this volume has been balanced by recharge, water levels have declined more than 400 ft in some basins. The basins of the study area are grouped into five categories on the basis of geologic and hydrologic properties. The groups are: (1) southeast, (2) central, (3) west, (4) Colorado River, and (5) highland. The character of the sediments filling the basins and the important flow components are similar within a category. The effect of development on the aquifer system and changes in flow components generally can be evaluated for each category by model simulation. (See also W87-07312) (Lantz-PTT)
W87-07320

CENTRAL MIDWEST REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Lawrence, KS. Water Resources Div.
D. G. Jorgensen, R. B. Leonard, D. C. Signor, and J. O. Helgesen.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 132-140, 5 fig, 7 ref.

Descriptors: *Aquifer systems, *Central Midwest Aquifer, *Groundwater resources, *Groundwater

movement, *Geohydrology, Hydraulic properties, Rocks, Rock properties, Hydrologic properties.

The Central Midwest regional aquifer system study was started in 1980 and is scheduled for completion in 1986. The study area extends eastward from the foothills of the Rocky Mountains in Colorado to the valleys of the Missouri and Mississippi Rivers, and extends southward from northern Nebraska to south-central Arkansas. The area includes the Ozark Plateau and a large part of the Great Plains. The sedimentary rocks underlying the study are, except in the St. Francois Mountains, are generally water-yielding formations and range in thickness from a featheredge where they pinch out against the St. Francois Mountains to more than 40,000 ft in the Anadarko Basin in central Oklahoma. The igneous and metamorphic basement rocks that underlie the water-yielding formations generally do not yield significant quantities of water to wells. Therefore, the surface of the basement rock effectively forms the base of the groundwater system in the study are. Hydraulic properties of the various rocks in the study area differ greatly. These rocks include sandstone, shale, and evaporites of Cretaceous, Jurassic, and Permian age; limestone and shale of Pennsylvanian and Mississippian age and Dolomite and sandstone of Silurian, Ordovician, and Cambrian age. Except in the Ozark Plateau, little is known about the groundwater flow, and it is probable that not all aquifers have been identified. In much of the study area, the water-yielding rocks are deeply buried, and groundwater related data are scarce except for data collected incidentally by the petroleum industry. Because the cost of collecting additional hydrologic data in the deep subsurface is prohibitive, special efforts and techniques are needed to evaluate and analyze existing data. (Lantz-PTT)
W87-07321

COLUMBIA PLATEAU BASALT REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Tacoma, WA. Water Resources Div.
J. Vaccaro.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 141-145, 3 fig, 3 ref.

Descriptors: *Aquifer systems, *Columbia Plateau, *Washington, *Oregon, *Groundwater resources, *Geohydrology, *Idaho, *Groundwater levels, Sodium, Irrigation, Aquifers, Permeability coefficient, Groundwater recharge, Basalts.

The basaltic rocks that compromise the regional aquifer underlying the Columbia Plateau are located in central and eastern Washington, northern Oregon, and a small part of northwestern Idaho. The Plateau covers about 70,000 sq mi entirely within the drainage of the Columbia River and is bordered on the west by the Cascade Range, on the north and east by the Rocky Mountains, and on the south by the Blue Mountains. Major tributaries to the Columbia River on the Plateau are the Snake, Spokane, John Day, Yakima, Palouse, and Deschutes Rivers. The topography of the Plateau is varied and includes: (1) major mountains consisting of a geologically young folded region of large anticlines and synclines, and (2) low relief features. The Columbia Plateau Basalt regional aquifer system study was started in 1982 and is scheduled for completion in 1986. The study was designed to address some of the hydrologic problems currently being encountered on the plateau. These problems include: (1) declining water levels of as much as 20 ft/yr; (2) the occurrence of sodium-enriched water; (3) the need for additional groundwater for expanding irrigated land; (4) the lack of knowledge of the effects of increased development of the aquifer system; (5) the lack of knowledge of interaction between groundwater and surface water; and (6) the potentiality of using the low-permeability zones of the deep basalts as a national repository site for solidified high-level nuclear wastes near Richland, WA. (See also W87-07312) (Lantz-PTT)
W87-07322

GREAT BASIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Carson City, NV. Water Resources Div.
J. R. Harrill.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 146-151, 3 fig.

Descriptors: *Groundwater resources, *Geohydrology, *Aquifer systems, *Great Basin, *Nevada, *Utah, *Groundwater movement, Groundwater potential, Groundwater level, Flow profiles, Pumping, Permeability coefficient.

The Great Basin regional aquifer system study was started in 1980 and is scheduled for completion in 1985. The study area encompasses about 140,000 sq mi in parts of Nevada, Utah, and adjacent States. The area is characterized by generally north-trending mountain ranges which have a width ranging from 5 to 15 miles. In recent years, much of the study area has been considered for use by the MX missile system; large coal-fired powerplants are being constructed at several locations, and the potential for disposal of solidified high-level radioactive waste at the Nevada Test Site is being studied. These activities will greatly affect the groundwater resources in much of the study area within the next several decades. Impacts from existing and anticipated developments would have both regional and local effects. However, most of the known water resources, which include the surface water and much of the groundwater in basin-filled deposits, are either used or appropriated to the extent of current estimates of their availability. The objective of this study is to describe the aquifer systems in the Great Basin and, to the extent possible, develop techniques that can be used for quantitative evaluation of the aquifer systems. The regional flow of the Great Basin aquifer system is based primarily on the lowest water level altitudes in each basin. The regional flow is apparently toward either the Colorado River or major regional discharge areas. The 242 identified basin areas had been grouped into 39 major flow systems. Geochemical studies of the White River groundwater flow system suggest that the system can be further subdivided into several subsystems, with relatively small quantities of flow between the subsystems. Regional analysis of hydrologic conditions in southwestern Utah suggests that the transmissivity of the carbonate rocks is higher than originally anticipated, and that some degree of hydraulic continuity exists between basins throughout that part of the area. (See also W87-07312) (Lantz-PTT)
W87-07323

GULF COASTAL PLAIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Austin, TX. Water Resources Div.
H. F. Grubb.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 152-161, 4 fig, 2 tab, 17 ref.

Descriptors: *Aquifer systems, *Gulf Coast Aquifer, *Alabama, *Arkansas, *Groundwater resources, *Geohydrology, *Florida, *Illinois, *Kentucky, *Groundwater movement, *Missouri, *Mississippi, *Tennessee, *Texas, Groundwater potential, Flow profiles, Simulation analysis, Data collections.

The Gulf Coast Plain regional aquifer system study was started in 1980 and is scheduled for completion in 1988. The study area includes about 225,000 sq mi of the Gulf Coast Plain in parts of Alabama, Arkansas, Florida, Illinois, Kentucky, Mississippi, Missouri, Tennessee, and Texas and all of Louisiana. The thick wedge of sediments of Tertiary and younger age, yields large quantities of water for municipal, industrial, and agricultural use. In addition to the objectives of all RASA studies, specific objectives or approaches of this study include: (1) evaluation of effects of highly saline water on the regional flow system, and (2) evaluation of potential for compaction of confining units as a result of changes in fluid pressures. The principal findings of the study, as of 1984, consist largely of the development of a conceptual framework for studying the regional aquifers, identification of data sources, compilation of the data into computer files, and preliminary simulations of the groundwater flow system. (See also W87-07312) (Lantz-PTT)
W87-07324

NORTHEAST GLACIAL REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Albany, NY. Water Resources Div.
F. P. Lyford.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 162-167, 6 fig, 4 ref.

Descriptors: *Aquifer systems, *Groundwater resources, *Geohydrology, *Northeast Glacial Aquifers, *Groundwater movement, Hydrologic properties, Pumping, Groundwater potential, Glacial sediments.

The regional assessment of the Northeast glacial aquifers was started in 1981 and is scheduled for completion in 1986. The purpose of the study is to investigate the sand and gravel aquifers that were formed during advances and retreats of the continental glaciers in the northeastern United States. This study will document the hydrologic characteristics of the glacial aquifers in the northeastern United States through study of the variations in magnitude and areal distribution of key components of the aquifers and through evaluation of the response of the aquifers to pumping and to climatic stresses. The study area includes most of the glaciated parts of the northeastern United States and extends approximately as far west as the edge of the glaciated Appalachian Plateau in Ohio. The areas of Long Island, NY, and Cape Cod, MA, are excluded from the study because the groundwater hydrology of these systems has been extensively studied. The study area includes several physiographic provinces, which range from mountainous areas such as the White Mountains of New Hampshire and Maine, the Green Mountains of Vermont, and the Adirondack and Catskill Mountains of New York; to low-lying areas along the Great Lakes, the St. Lawrence River valley, the Hudson and Mohawk River valleys; and seaboard lowland areas along the Atlantic coast. (See also W87-07312) (Lantz-PTT)
W87-07325

NORTHERN ATLANTIC COASTAL PLAIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Trenton, NJ. Water Resources Div.
H. Meisler.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 168-194, 22 fig, 20 ref.

Descriptors: *Aquifer systems, *Northern Atlantic Coastal Plain Aquifer, *Groundwater resources, *Geohydrology, *New York, *Groundwater movement, *Maryland, *North Carolina, Groundwater recharge, Limestones, Sand, Silt, Clays, Groundwater mining, Groundwater potential, Precipitation.

The northern Atlantic Coastal Plain is a gently rolling to flat region of about 50,000 sq mi. The study area extends along the Atlantic coast from Long Island, NY, to North Carolina. It is underlain by a wedge of predominantly unconsolidated sediments that thickens from a feather edge at the Fall Line to 8,000 ft along the coast of Maryland and 10,000 ft at Cape Hatteras, NC. The sediments consist mostly of sand, silt, clay, and gravel of Jurassic to Holocene age. Limestone occurs in North Carolina. A regional aquifer system study of the Northern Atlantic Coastal Plain was begun in 1979 and is scheduled for completion in 1986. This sedimentary wedge forms a complex aquifer system in which the sand, gravel, and limestone

function as aquifers, whereas the clay and silt act as confining units. Withdrawal of water from this system, principally for municipal and industrial use, has grown from about 100 Mgal/d in 1900 to about 1,200 Mgal/d in 1980. Recharge to the northern Atlantic Coastal Plain aquifer system is derived from precipitation and occurs chiefly in upland and interfluvial areas. It ranges from 10 to 25 in/yr, but most of this water flows only through the shallow unconfined parts of the system and discharges to local streams that dissect the Coastal Plain. A small amount of precipitation, generally less than 1 in/yr, recharges the deeper confined aquifers. Under natural conditions, discharge from the deeper aquifers is primarily upward across the confining units into shallower aquifers and ultimately into the sea or coastal estuaries, sounds, and bays. (See also W87-07312) (Lantz-PTT)
W87-07326

OAHU ISLAND REGIONAL AQUIFER-SYSTEM STUDY, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
C. J. Ewart.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 195-204, 9 fig, 1 tab, 9 ref.

Descriptors: *Aquifer systems, *Hawaii, *Oahu, *Groundwater potential, *Groundwater resources, *Geohydrology, Volcanoes, Coastal plains, Groundwater movement, Groundwater storage, Saline water, Permeability coefficients.

Several recent studies have concluded that the groundwater resource of the Island of Oahu will be near maximum development by the year 2000. Estimates of the long-term potential of groundwater development of the Oahu regional aquifer system range between 480 and 635 Mgal/d. In 1980, the groundwater withdrawal rate was about 400 Mgal/d, which is 85% of the island's total water use. Development of this magnitude unquestionably imposes substantial stresses on the aquifer system. To establish background information and to evaluate the impact of the potential development, a study of the Oahu regional aquifer system was started in 1982 and is scheduled for completion in 1986. Compilation of a hydrologic database for all aquifers is virtually completed. From available data, interpretation of information on hydrology and hydraulics of three of the ten identified aquifers has been completed. Because all the aquifers are interrelated to some extent, the ten identified aquifers are grouped into five areas for simulation purposes. They are: (1) Southeast basal water body (southeast area); (2) Honolulu-Pearl Harbor basal water body (southern area); (3) Koolau dike-impounded water body and the northeast basal water body (windward area); (4) Kawailoa, Waialua, and Mokuleia basal water bodies (north-central area); and (5) Waianae dike-impounded and basal water bodies (Waianae area). The Schofield high-level water body is tributary to the southern and the north-central areas. Therefore the Schofield high-level water body is included in the simulation of both the southern and the north-central areas. (See also W87-07312) (Lantz-PTT)
W87-07327

SOUTHEASTERN COASTAL PLAIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Atlanta, GA.
R. L. Wait, R. A. Renken, R. A. Barker, R. W. Lee, and V. Stricker.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 205-222, 12 fig, 1 tab, 8 ref.

Descriptors: *Aquifer systems, *Southeastern Coastal Plains Aquifer, *South Carolina, *Groundwater resources, *Georgia, *Mississippi, *Alabama, *Florida, *North Carolina, *Geohydrology, *Surface-groundwater relations, *Groundwater movement, Water sampling, Groundwater recharge, Precipitation, Runoff, Evapotranspiration.

Clastic sediments of Cretaceous and Tertiary age in South Carolina, Georgia, Alabama, Mississippi, and adjacent areas of northern Florida and southwestern North Carolina comprise a major aquifer system that underlies an area of about 130,000 sq mi and is informally called the Southeastern Coastal Plain aquifer system. No previous hydrologic studies have considered the Southeastern Coastal Plain aquifer system as a single system. For the most part, this study is based on information from previous studies. However, some additional data were collected to fill major gaps in information. For example, three test wells were drilled between 1980 and 1983 (one in western Alabama; one each in central and eastern South Carolina) to fill voids in the data. In addition, a four-State mass measurement of water levels was made in 1982 to evaluate the decline of water levels in different hydrogeologic units. Water samples were collected from 105 wells over the four-State area and were filtered and measured for pH, conductivity, temperature, trace metals, stable and radioactive isotopes, nutrients, and dissolved gases. Rainfall ranges from 44 to 64 inches in the study area. Most of the rainfall that enters this clastic system is discharged to nearby streams and rivers. The average hydrologic conditions in the study area can be summarized as follows: precipitation is approximately 50 in/yr, overland runoff is approximately 7 in/yr, evapotranspiration is approximately 35 in/yr, and recharge to the aquifer system is approximately 8 in/yr. Most of this recharge eventually discharges into streams or rivers as base flow through shallow, local scale aquifers; however, a small amount, about 1 in/yr, recharges downward into the deeper aquifers. The quality of groundwater has been adversely affected locally by heavy pumping which has caused an increase in concentrations of dissolved solids in several areas. (See also W87-07312) (Lantz-PTT)
W87-07328

UPPER COLORADO RIVER BASIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Denver, CO. Water Resources Div.
O. J. Taylor, G. Freethey, and K. C. Glover.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 223-233, 6 fig, 8 ref.

Descriptors: *Aquifer systems, *Colorado River, *River basins, *Wyoming, *Groundwater resources, *Colorado, *Utah, *Arizona, *New Mexico, *Geohydrology, *Surface-groundwater relations, Geography, Aquifers, Tectonics, Precipitation, Groundwater recharge, Rainfall.

Water shortage is common in the Colorado River basin and increasing water demand is expected. The Colorado River Compact of 1922 divided the Colorado River Basin into an upper and a lower basin in order to allocate water supplies. The Upper Colorado River Basin has a drainage area of about 113,500 sq mi in western Colorado, eastern Utah, southwestern Wyoming, northeastern Arizona, and northwestern New Mexico. Local studies of the groundwater resources in the Upper Colorado River Basin are numerous; however, regional studies are few. To obtain additional regional information systematically on hydrology, geology, and water chemistry of the Upper Colorado River Basin aquifer system, in 1981, the U.S. Geological Survey started the Upper Colorado River Basin regional aquifer study, scheduled for completion in 1986. The area covered by this study contains a variety of landforms: rugged mountains, broad plains, deeply dissected canyons, relatively flat flood plains, and many erosional features. Consolidated sedimentary formations of Paleozoic, Mesozoic, and Cenozoic age attain a maximum thickness of tens of thousands of feet. These formations include aquifers within beds of fractured limestone, dolomite, sandstone, and shale. Low permeability limestone, dolomite, shale, and evaporite deposits act as confining units. Igneous rocks, especially volcanic rocks are also present in part of the study area, but they are not regional aquifers. The study area has been subjected to repeated tectonism. The predominant tectonic features are numerous basins and uplifts. The resulting structural relief is nearly 30,000 ft above the basin floors in places. Because of this relief, several aquifers that are deeply buried in basins are exposed on the margins of uplifts, where precipitation partly recharges the aquifers. Aquifers within stratigraphically younger formations tend to be exposed and recharged over extensive areas. Annual precipitation ranges from approximately 6 inches on the plains of Utah to about 40 inches in mountainous areas. Precipitation, in form of snowmelt and rainfall, is the only source of recharge to the aquifers. (See also W87-07312) (Lantz-PTT)
W87-07329

CARIBBEAN ISLANDS REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, San Juan, PR. Water Resources Div.
F. Gomez-Gomez.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 234-241, 4 fig, 5 ref.

Descriptors: *Aquifer systems, *Carribean Islands, *Puerto Rico, *Groundwater resources, *Geohydrology, *St. Croix, *St. Thomas, *St. John, *Rainfall-runoff relationships, Rainfall, Groundwater recharge, Surface-groundwater relations, Model studies, Flow profiles, Aquifers, Groundwater movement.

The Caribbean Island regional aquifer system includes Puerto Rico, its offshore islands, and the U.S. Virgin Islands (St. Croix, St. Thomas, and St. John). However, the regional aquifer system study will investigate only the aquifers underlying the islands of Puerto Rico and St. Croix. The island of Puerto Rico has an area of about 3,300 sq mi. It consists of a series of east-to-west mountain ranges with a maximum altitude of about 4,400 ft, flanked on the north and south by foothills. Extensive coastal plains as much as 8 miles in width exist along the north and south coasts. Rainfall ranges from 200 inches in the rain forests of the northeast to 35 inches in the lowlands of the southwest. The annual average rainfall is about 75 inches. Streamflow varies seasonally with precipitation and topography. The regional aquifer system study will entail compilation of existing information and development of computer-based flow models to understand the flow systems, to evaluate the potential for seawater encroachment near the coast, and to study the effects of change in irrigation patterns. An ongoing cooperative investigation with the Department of Natural Resources of the Commonwealth of Puerto Rico includes studying the occurrence and movement of groundwater in the North Coast Ground-Water Province. This cooperative project involves developing flow models; therefore, the effort of the Caribbean Islands regional aquifer system study on the north coast interacts closely with the cooperative study and will be concentrated on geochemistry as well as the interconnection between streams and the shallow water table aquifers. The regional aquifer system study also will entail some exploratory drilling to fill the information gap in the data base. In St. Croix, a groundwater flow model of the Kingshill aquifer will be developed and calibrated. Saltwater encroachment as a result of groundwater development also will be investigated. (See also W87-07312) (Lantz-PTT)
W87-07330

MICHIGAN BASIN REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Reston, VA. Water Resources Div.
L. A. Swain.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 242-244, 1 fig, 2 ref.

Descriptors: *Aquifer systems, *Michigan, *Groundwater resources, *Geohydrology, *Groundwater movement, *Saline water, Glacial aquifers, Sandstone, Pumping, Groundwater potential, Flow profiles, Permeability coefficient.

Michigan lies in a great structural bedrock depression - the Michigan Basin. The youngest bedrocks are at the center of the basin, and the oldest bedrocks crop out along the basin circumference. The important aquifers in the Michigan Basin are glacial aquifers and sandstone aquifers of the Marshall and Saginaw Formations of Paleozoic age. The Michigan Basin regional aquifer system study is designed to investigate the glacial aquifers and the underlying sandstone aquifers which cover about two-thirds of the lower peninsula of the State of Michigan. In 1980, about 220 Mgal/d of groundwater was pumped for water supplies. Of this, about 60% of the water was pumped from the glacial aquifers, 25% from the Saginaw and Marshall Formations, and the remaining 15% from other hydrogeologic units, such as the unnamed redbeds and Grand River Formations of Pennsylvania age. To ensure that sufficient groundwater can be developed in the basin, it is critical to know the relation between development of groundwater in the Michigan Basin and the movement of the saline water. The study will use variable density flow models to evaluate all hypotheses and to understand the flow system, from land surface down to a major confining unit of the Coldwater Shale of early Mississippian age, before development and after development. The Coldwater Shale was chosen as the lower boundary of the flow system due to its low permeability. Therefore, the study area is bound by the contact between the Coldwater Shale and the Marshall Formation, the lowermost formation of the studied aquifer system. The established flow models will be used to evaluate the impact of future development. (See also W87-07312) (Lantz-PTT)
W87-07331

SOUTHERN CALIFORNIA ALLUVIAL BASINS REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, San Diego, CA.
P. Martin.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 245-247, 1 fig.

Descriptors: *Aquifer systems, *California, *Groundwater resources, *Alluvial basins, *Geohydrology, *Saline water intrusion, *Groundwater movement, Groundwater recharge, Groundwater quality.

The southern California alluvial basins regional aquifer system study is scheduled for completion within 4 to 5 years. The study will be conducted in two parts: (1) the first part will produce a comprehensive bibliography and report that will characterize regional groundwater conditions and identify the major groundwater problems and issues; and (2) the second part of the study will describe and categorize the regional geohydrology of the alluvial basins and analyze the major problems and issues that affect the utilization of groundwater. The geohydrology of the alluvial basins is described using extensive data files and published reports. The study area includes 88 identified alluvial basins which will be grouped according to common characteristics and relationships. Elements that will be used to categorize the basins include: (1) depositional history of the basin fill, (2) groundwater flow characteristics; (3) recharge and discharge characteristics, and (4) water quality. Three major water problems or issues have been selected for detailed investigations. They are: (1) saltwater intrusion in coastal basins, (2) flow between aquifer layers, and (3) the quantity and distribution of recharge in coastal and desert basins. The study plans for the different investigations are discussed. (See also W87-07312) (Lantz-PTT)
W87-07332

FLORIDAN REGIONAL AQUIFER SYSTEM, PHASE II STUDY,
Geological Survey, Atlanta, GA.
P. W. Bush, J. A. Miller, and M. L. Maslia.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 249-254, 3 fig, 1 ref.

Descriptors: *Aquifer systems, *Florida, *Petrography, *South Carolina, *Groundwater movement, *Groundwater resources, *Geohydrology, *Hilton Head Island, *Georgia, *Saline water intrusion, Groundwater movement, Pumping, Groundwater mining, Potentiometric level, Groundwater management.

The Floridan regional aquifer-system study investigated and described the flow system from a regional and subregional perspective. During the course of that study, local aspects of the system that merited continued or more detailed work were noted but were not dealt with in order to fulfill the broader objectives of the initial study. The purpose of the Floridan regional aquifer-system phase II study is to investigate some of these local aspects. The phase II study was started in 1983 and is scheduled for completion in 1986. Four investigations are part of the phase II study. The locations of these investigations are: (1) petrographic study, central Florida; (2) saltwater movement study, Hilton Head Island, South Carolina; (3) effects of increased pumpage, southwest Georgia and northwest Florida, and (4) regional potentiometric-surface map, 1985. (See also W87-07312) (Lantz-PTT)
W87-07333

HIGH PLAINS REGIONAL AQUIFER SYSTEM, PHASE II STUDY,
Geological Survey, Denver, CO. Water Resources Div.
J. B. Weeks.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 255-258, 1 fig, 3 ref.

Descriptors: *Aquifer systems, *High Plains Aquifer, *Water use, *Groundwater resources, *Geohydrology, *Groundwater mining, Model studies, Groundwater management, Pumping, Groundwater mining, Flow profiles, Groundwater level, Aquifers, Irrigation.

The initial High Plains regional aquifer study provided a regional description of the aquifer system and calibrated regional groundwater flow models. The models were calibrated on the basis of water level changes from predevelopment to 1980. Pumpage and irrigation return flow are two poorly known factors, however, they are critical for simulation. An indirect method for estimating pumpage was developed during the initial study; irrigation return flow was adjusted during model calibrations. The accuracy of pumpage estimates and an independent estimate of irrigation return flow are essential to developing more accurately calibrated flow models. The groundwater flow models developed during the initial study are capable of projecting future water levels in the aquifer resulting from the strategies proposed by a study of the Economic Development Administration (EDA) of the U.S. Department of Commerce. However, the accuracy of the water level projections cannot be evaluated unless the accuracy of information on pumpage and irrigation return flow are evaluated, which was not pursued during the initial study. For this reason, a phase II study was started in 1982 and is scheduled for completion in 1986. (See also W87-07312) (Lantz-PTT)
W87-07334

SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM, PHASE II STUDY,
Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm.
IN: Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of Projects, 1978-84, U.S. Geological Survey Circular 1002, 1986. p 259-261, 1 fig.

Descriptors: *Aquifer systems, *Snake River, *Hydrologic properties, *Groundwater resources, *Geohydrology, *Groundwater movement, Flow profiles, Model studies.

During phase I of the Snake River Plain regional aquifer-system study, several areas were identified for more detailed study. Long-term regional hydrologic changes were successfully simulated using quasi three-dimensional groundwater flow models. However, in key local areas the desired degree of understanding was not satisfactorily achieved with the large-scale regional flow models. Data needs to be collected and incorporated into smaller scale local flow models that will be developed during phase II studies. A stream-aquifer model of the eastern Snake River Plain is also scheduled to be developed. This report provides brief descriptions of these key studies. (See also W87-07312) (Lantz-PTT)
W87-07335

GROUNDWATER FORECASTING,
Geological Survey, Reston, VA.
L. F. Konikow, and E. P. Patten.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 221-270, 11 ref, 52 ref.

Descriptors: *Groundwater forecasting, *Hydrologic models, *Model studies, *Groundwater management, *Groundwater quality, Water use, Water supply.

Groundwater is generally beneficial in its interactions with other elements of the hydrological cycle and with mankind. For example, groundwater reservoirs serve as moderators of hydrological extremes. Groundwater discharge provides and sustains streamflow during droughts, and groundwater recharge from floods attenuates the flood peaks as they propagate downstream. An increase in groundwater use partly reflects the now widespread recognition by local and regional water-resource planners of the desirability of considering groundwater as part of the total water resource. It is also becoming increasingly evident that issues of groundwater supply cannot be divorced from consideration of groundwater quality; and ultimately both issues must be reconciled with economics. Because all water-supply sources are subject to both natural and man-induced variations of volumes in storage, planners and managers often rely on forecasts or predictions of future conditions as a partial basis for their water planning. The purpose of this chapter is to review the use and reliability of deterministic models for predicting future changes in groundwater quantity and quality. Examples of generic groundwater flow and solute-transport models are presented to illustrate the numerical theory and physical basis of these deterministic simulation approaches. Applications of both types of models to field problems will be analyzed to illustrate their application under the real-world constraints of uncertainty in parameters, approximation of processes, and errors in measurement. (See also W87-07346) (Lantz-PTT)
W87-07355

GRAVEL PACK THICKNESS FOR GROUNDWATER WELLS - REPORT NO. 1,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8A.
W87-07391

DIRECT COMPARISON OF KINETIC AND LOCAL EQUILIBRIUM FORMULATIONS FOR SOLUTE TRANSPORT AFFECTED BY SURFACE REACTIONS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W87-07474

STOCHASTIC THEORY OF FIELD-SCALE FICKIAN DISPERSION IN ANISOTROPIC POROUS MEDIA,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W87-07475

CHANNEL MODEL OF FLOW THROUGH FRACTURED MEDIA,
California Univ., Berkeley. Lawrence Berkeley

Lab.
For primary bibliographic entry see Field 5B.
W87-07476

MASSIVE GROUNDWATER FIX STUDIED,
For primary bibliographic entry see Field 5G.
W87-07541

2G. Water In Soils

SORPTIVITY VARIATION DURING INFILTRATION,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
Y.-S. Fok.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1808-1810, November-December 1985. 1 fig, 1 tab, 19 ref.

Descriptors: *Sorptivity, *Infiltration, *Mathematical equations, *Soil properties, Equations, Hydraulics, Temporal distribution.

Sorptivity, a constant, as defined by the Philip two-term algebraic infiltration equation, has been of interest to researchers because its development is based on the physical analysis of soil hydraulic properties. The mathematical variations of sorptivity under prolonged infiltration time are presented, and a guide to evaluation of sorptivity for infiltration computation as prescribed by Fok linearized two-term infiltration equations is provided. (Author's abstract)
W87-06642

SOIL WATER INFILTRATION AS AFFECTED BY THE USE OF THE PARAPLOW,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
S. Mukhtar, J. L. Baker, R. Horton, and D. C. Erbach.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1811-1816, November-December 1985. 4 fig, 5 tab, 33 ref.

Descriptors: *Infiltration, *Corn, *Tillage effects, *Paraplow, *Soil water, Density, Soil properties, Iowa, Comparison studies, Cracks, Moisture content.

Double-ring infiltration measurements were made during the corn growing season to determine the effect of various tillage systems on 1- and 30-min cumulative infiltration at three locations in Iowa. The Paraplow, a newly introduced tillage tool in North America, which loosens the soil but does not invert it, was compared with moldboard-plow, chisel-plow, and no-tillage treatments. The Paraplow treatment gave the highest 1- and 30-min cumulative infiltration throughout the growing season. Similar bulk densities to a depth of 10 cm were observed for all the tillage at one site where moldboard-plowed and chisel-plowed soils had the lowest bulk densities. No-tillage and Paraplow treatment plots generally had greater moisture contents in the top 10 cm. Deep, surface connected cracks enhanced soil water infiltration considerably, and residue cover, particularly on the surface of no-tillage and Paraplow treatment plots, seemed to prevent surface sealing that would restrict soil water infiltration. (Author's abstract)
W87-06643

PREDICTING INFILTRATION FOR SHALLOW WATER TABLE SOILS WITH DIFFERENT SURFACE COVERS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
A. Shirmohammadi, and R. W. Skaggs.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1829-1837, November-December 1985. 11 fig, 2 tab, 26 ref.

Descriptors: *Shallow water table, *Infiltration, *Surface cover, *Model studies, Prediction, Soil columns, Hydraulic conductivity, Field crops, Water table.

Two approximate methods were used to predict infiltration for shallow water table conditions. The method proposed by Bouwer (1969) was modified so that it would predict saturated flow through the column after the water table rose to the surface; air pressure ahead of the wetting front was not considered in this method. The second method which did consider the air impedance, was a three-stage model based on the work of Adrian and Franzini (1966). Results of these two prediction models were compared with experimental infiltration measurements on soil columns with three different surface conditions: fallow or bare, soybean, and fescue grass. Comparisons were made at different stages of the crop production cycle. Results showed that the three-stage model gave better predictions than the modified Bouwer's model for the conditions considered in this study. When original saturated hydraulic conductivity values were used, all prediction models underestimated infiltration for profiles with grass surface cover and overestimated infiltration for profiles without a surface cover. Much better predictions were obtained when hydraulic conductivities were measured after the crop had been established or, in the case of bare profiles, after the surface had been weathered or disturbed. (Author's abstract)
W87-06646

SPATIAL VARIABILITY OF INFILTRATION IN FURROWS,
Instituto Tecnologico y de Estudios Superiores de Monterrey (Mexico).
E. Bautista, and W. W. Wallender.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1846-1851, 1855, November-December 1985. 8 fig, 3 tab, 17 ref.

Descriptors: *Infiltration, *Furrow irrigation, *Irrigation design, *Spatial distribution, *Furrows, *Irrigation, *Autocorrelogram, *Crosscorrelogram, Stagnant water, Ponding, Flow.

The mean and spatial variability of infiltration measured with rings, blocked furrows with stagnant ponded water, blocked furrows with flowing water, and blocked furrows with surge flow were evaluated. Infiltration is generally greater with water flowing in blocked furrows than stagnant tests, especially on cracked soil. Spatial variability of cumulative infiltration is greater than for quasi-steady infiltration and the distance over which samples are spatially related is also greater for cumulative infiltration. Blocked furrow measurements with flowing water are preferred to the other stagnant tests because they more closely duplicate conditions under furrow irrigation. Spatial variability of infiltration characteristics should be included in evaluating the performance of furrow irrigation systems. The autocorrelogram is introduced as a tool to determine distance between samples to avoid spatial correlation and thus get the maximum new information regarding variability from sampling. A similar tool, the crosscorrelogram shows promise for estimating blocked furrow intake from ring infiltration tests. (Author's abstract)
W87-06648

NEAR INFRARED REFLECTANCE SOIL MOISTURE METER,
Tokyo Univ. of Agriculture and Technology (Japan).
For primary bibliographic entry see Field 7B.
W87-06649

NUMERICAL SIMULATION OF THE CONVECTIVE TRANSPORT OF A NONINTERACTIVE CHEMICAL THROUGH AN UNSATURATED/SATURATED POROUS MEDIA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W87-06651

WATER TABLE EFFECTS ON NUTRIENT CONTENTS OF CELERY, LETTUCE AND SWEET CORN,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, and M. Rosen.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1867-1870, November-December 1985. 3 tab, 8 ref.

Descriptors: *Water table, *Nutrients, *Celery, *Lettuce, *Corn, *Lysimeters, *Food crops, *Biomass, Agriculture, Fertilizers, Limiting nutrients, Productivity, Crop yield, Accumulation.

A system of lysimeters filled with organic soil was used to study the dry biomass and nutrient contents (TKN, Total-P, K, Ca, Mg) of celery, lettuce and sweet corn in relation to water tables. The water tables were controlled at high (0.30 m for celery and sweet corn, and 0.45 m for lettuce), medium (0.60 m), and low (0.85 m) levels with three replications. Dry biomass varied from 791 to 1173 g/sq m for celery, from 300 to 376 g/sq m for lettuce, and from 1030 to 1294 g/sq m for sweet corn. Plant nitrogen uptakes in high, medium, and low water tables were, respectively, 14.0, 17.8, and 20.9 g/sq m for celery; 8.9, 11.4, 11.2 g/sq m for lettuce; and 11.6, 11.9, and 20.0 g/sq m for sweet corn. For Total-P, the corresponding value ranges were, respectively, 3.6, 3.1, and 3.0 g/sq m for celery; 2.0, 1.7, 1.6 g/sq m for lettuce; and 3.4, 2.9, and 2.6 g/sq m for sweet corn. For magnesium, the corresponding value ranges were, respectively, 4.0, 5.0, and 5.0 g/sq m for celery; 1.3, 1.8, and 2.0 g/sq m for lettuce; and 2.2, 3.3, and 3.2 g/sq m for sweet corn. For potassium the corresponding value ranges were respectively, 54.7, 40.0, and 32.8 g/sq m for celery; 24.6, 22.6, and 23.0 g/sq m for lettuce; and 28.9, 30.0, and 29.7 g/sq m for sweet corn. For calcium, the corresponding value ranges were, respectively, 32.7, 31.4, and 28.6 g/sq m for celery; 4.2, 4.6, and 4.3 g/sq m for lettuce; and 3.6, 5.1, and 5.2 g/sq m for sweet corn. Although maintaining a high water table to reduce the organic soil subsidence can reduce the nitrogen and phosphorous problems in the Everglades Agricultural Area, a practical consideration is that this practice may also cause nitrogen and magnesium deficiencies which will require growers to use nitrogen and magnesium fertilizers for crop production. (Author's abstract)
W87-06652

FURROW HYDRAULIC CHARACTERISTICS AND INFILTRATION,
Colorado State Univ., Fort Collins.
B. Izadi, and W. W. Wallender.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1901-1908, November-December 1985. 10 fig, 5 tab, 19 ref.

Descriptors: *Infiltration, *Furrows, *Flow rates, *Statistical analysis, *Furrow irrigation, *Irrigation, *Loam, *Clays, *Surface flow, *Cracks, Soil types, Soil water, Geometry, Estimating, Deposition, Hydraulics.

The influence of temporally varying flow rate and surface depth on measured infiltration, furrow roughness, and geometry were compared using classical and regionalized statistical theory. Flowing conditions, rather than stagnant water, enhanced intake on cracked Yolo clay loam whereas rapidly increasing surface flow depth enhanced infiltration on the same soil with fewer cracks. There is a significant cross-correlation between wetted perimeter and infiltration where cracks and holes do not dominate infiltration. The measurements were not correlated for distances of 8 m or more, however. Roughness decreased and the furrow geometry became more hydraulically efficient during irrigation. Displacement tests and cross-section measurements suggest that soil swelling may inflate estimates of deposition in furrows. Dewatering after the first surge in surge irrigation decreased deposition. (Author's abstract)
W87-06658

HYDROPHYSICAL MODIFICATION OF A SANDY SOIL AND ITS EFFECT ON EVAPORATION,
Guelph Univ. (Ontario). Dept. of Land Resource Science.

For primary bibliographic entry see Field 2D.
W87-06662

ANISOTROPY OF A FRAGIPAN SOIL: VERTICAL VS. HORIZONTAL HYDRAULIC CONDUCTIVITY,
Louisiana Agricultural Experiment Station, Baton Rouge.
S. M. Dabney, and H. M. Selim.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 3-6, January-February 1987. 1 fig, 3 tab, 19 ref.

Descriptors: *Anisotropy, *Hydraulic conductivity, *Permeability coefficient, *Moisture content, *Soil horizons, *Soil water movement, Fragipan, Density, Soil water, Soil cores, Soil types, Silt, Loam, Flow.

Undisturbed core samples were obtained in vertical and horizonal directions from surface and subsurface horizons of an Olivier silt loam (Aquic Fragiudalfs, fine-silty, mixed, thermic) in order to test for anisotropy. Saturated hydraulic conductivity, bulk density, penetrometer resistance, and volumetric moisture content at soil matric potential of 30 J/kg were measured. Hydraulic conductivity values within the Ap did not differ in horizontal and vertical sampling directions. However, within the Btx1 horizon, measured conductivity values were three times greater in vertical than in horizontal directions. This was attributed to the primarily vertical orientation of flow-restrictive zones within the fragipan. Bulk density and moisture content differed between surface and subsurface horizons, but were not influenced by direction of core sampling. Penetrometer resistance did not differ between horizons or sampling direction, but was significantly greater in brown than in grey areas of the fragipan. The results of this study have relevance to models of soil water flow and the sampling methods described should be applicable to testing for anistropy in other soils. (Author's abstract)
W87-06790

SOIL-WATER PROPERTIES AS AFFECTED BY TWELVE ANNUAL APPLICATIONS OF CATTLE FEEDLOT MANURE,
Department of Agriculture, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, and C. Chang.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 7-9, January-February 1987. 2 tab, 16 ref.

Descriptors: *Infiltration, *Soil amendments, *Land disposal, *Waste disposal, *Manure, *Soil water, Available water, Hydraulic conductivity, Permeability coefficient, Soil cores, Irrigation, Animal wastes, Field tests, Fertilizers.

A long-term study was set up to determine the effects of annual applications of manure, at rates in excess of the recommended, on a Dark Brown Chernozemic (Typic Haploborolls) soil. Cattle (Bos taurus) feedlot manure was applied at 0, 30, 60 and 90 Mg/ha to nonirrigated and 0, 60, 120, and 180 Mg/ha to irrigated land at the Lethbridge Research Station. Soil-water properties of the soil at 0- to 15- to 30-cm depths, as affected by the manure, are reported. In the surface 15 cm of soil, the mean volume of plant-available water retained by the soil between 20 and 1500 kPa tension decreased with increasing rates of manure on both the nonirrigated and irrigated blocks of land. The saturated hydraulic conductivity of the soil cores and the infiltration rate of the soil in the field were unaffected by the applied manure. (Author's abstract)
W87-06791

WATER SEEPAGE THROUGH MULTILAYERED ANISOTROPIC HILLSIDE,
Louisiana Agricultural Experiment Station, Baton Rouge.
H. M. Selim.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 9-16, January-February 1987. 10 fig, 3 tab, 16 ref.

Descriptors: *Soil water movement, *Groundwater movement, *Anisotropy, *Mathematical studies, *Numerical analysis, *Saturated flow, *Slopes, *Seepage, *Hydraulic conductivity, *Permeability coefficient, Soil water, Flow rates, Soil layers, Flow.

A mathematical analysis is presented for the steady-state saturated flow through multilayered hillsides or soil beddings with a sloping surface. Each soil layer was considered anisotropic in nature, i.e., kappa not = xi where kappa and xi are the hydraulic conductivity in the vertical and horizontal directions, respectively. The method of solution is an analytical one and is based on the Gram-Schmidt orthonormalization technique. Potential and stream functions were obtained and flow nets are presented for two-layered geometries with varying degrees of anisotropy. The range of values chosen were xi = (1/25)kappa to xi = 16kappa and the equivalent hydraulic conductivities for two soil layers K1/K2 were 1:1, 1:10, and 10:1. The selected cases considered illustrate the significance of the degree of anisotropy on the water flow pattern, the relative flow rate as well as the volume of water passing through individual soil layers. Moreover, the greatest influence on the relative flow rate was when the upper layer was anisotropic rather than the lower layer. (Author's abstract)
W87-06792

INFLUENCE OF SPATIALLY VARIABLE SOIL HYDRAULIC PROPERTIES ON PREDICTIONS OF WATER STRESS,
Missouri Univ.-Columbia. Dept. of Agronomy.
S. H. Anderson, D. K. Cassel, and R. W. Skaggs.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 17-22, January-February 1987. 3 fig, 4 tab, 21 ref.

Descriptors: *Model studies, *Hydraulic conductivity, *Permeability coefficient, *Water stress, *Corn, *Crop yield, *DRAINMOD, *Drainage, *Infiltration, *Soil water, Prediction, Loam, Field tests, Water table, Simulation, Soil horizons, Soil properties.

Models are often used to predict drainage system effects on crop production. Variability of soil hydraulic properties on predictions made by many models have not been evaluated. Several methods for predicting water transport properties and corn (Zea mays L.) stress as influenced by variable soil hydraulic properties in a field of Portsmouth sandy loam (Typic Umbraquults) are evaluated. Upflux, drainage volume, and infiltration parameters as functions of water table depth were predicted using hydraulic conductivity and soil water retention functions for three soil horizons measured at 150 locations in a field. Crop stress due to both deficient and excess soil water conditions and relative crop yield were estimated using DRAINMOD, a water management simulation model, for three selected methods of averaging soil property inputs. Small differences existed among the three approaches for the 30-yr average relative corn yield. Large differences in relative corn yield occurred in dry years indicating that the variability of the soil properties was important to consider in predicting crop stress during relatively dry years. More information for the field soil-drainage response was obtained using the individual locations method which allowed soil property inputs to vary from location to location at each of the 150 points in the field. However, the field averages approach is more practical because fewer data are required to perform the necessary computations and only a 3% difference in the 30-yr relative yield resulted between the individual location and field average methods. (Author's abstract)
W87-06793

ESTIMATING SOIL WATER CONTENT USING COKRIGING,
Robert S. Kerr Environmental Research Lab., Ada, OK.
S. R. Yates, and A. W. Warrick.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 23-30, January-February 1987. 4 fig, 5 tab, 27 ref. Western Regional Project W-155.

Descriptors: *Cokriging, *Kriging, *Correlation analysis, *Moisture content, *Soil water, Estimating, Mathematical studies, Sand, Soil temperature, Spatial variation.

Using cokriging estimates, and estimation variances of the gravimetric moisture content (GMC) were made using one and two additional random functions: the bare soil surface temperature and the percent sand content. The semivariograms and cross-semivariograms were obtained as well as the sample correlation between the GMC and the auxiliary functions. Various measures of the differences and quality of the estimates for kriging and cokriging were calculated and compared on the basis of the sample correlation and whether the auxiliary random functions were over-sampled with respect to the GMC. The average estimation variance for cokriging compared to kriging was reduced for all levels of absolute sample correlation considered (i.e., 0.15-0.83). The mean sum of squares error between the actual and estimated values obtained by the jack-knifing technique was found to be lower for cokriging when compared to ordinary kriging when highly correlated auxiliary random variables were used but could be greater than that of ordinary kriging for less correlated auxiliary variables. It was found that the additional complexity of cokriging may be justified when the magnitude of the sample correlation exceeded 0.5 and the auxiliary functions were over-sampled with respect to the GMC. (Author's abstract)
W87-06794

STEADY THREE-DIMENSIONAL ABSORPTION IN ANISOTROPIC SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
J. R. Philip.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 30-35, January-February 1987. 4 fig, 2 tab, 15 ref.

Descriptors: *Mathematical studies, *Anisotropy, *Soil water, *Adsorption, *Pores, *Moisture potential, *Infiltration, *Hydraulic conductivity, *Permeability coefficient, Permeameters, Cavities, Flow, Equations.

Exact solutions are given for steady absorption from spheroidal cavities into soils with axisymmetric anisotropy independent of moisture potential. The needle, sphere, and disc are special cases. Apart from their direct relevance to systems with gravity negligible, the results yield the leading terms of expansions describing steady infiltration into such soils for small and moderate values of the dimensionless cavity length. The effectively wetted region is a spheroid with aspect ratio mu, where mu squared is the anisotropy. The analysis suggest that, in anisotropic soils, vertical conductivity influences the capillary component of flow much more strongly for disc permeameters than for borehole permeameters. Generalizations of the problem solved in detail involve (i) inequality of the three conductivity principal components, (ii) cavity axes skew to conductivity axes, (iii) ellipsoidal cavities. Any one, combination of two, or all three, of these generalizations leads to essentially the same mathematical problem with the solution expressible in terms of the incomplete elliptic integral of the first kind. (Author's abstract)
W87-06795

SOLUTE TRANSPORT THROUGH A STONY SOIL,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
R. Schulin, P. J. Wierenga, H. Fluhler, and J. Leuenberger.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 36-42, January-February 1987. 4 fig, 6 tab, 30 ref.

Descriptors: *Soil water movement, *Model studies, *Mathematical studies, *Solute transport, *Stony soil, *Tracers, *Isotope studies, *Leaching, *Convection, *Dispersion, Chlorides, Tritium, Equations, Interstitial water, Velocity, Pores, Transport, Solutes, Soil types, Flow.

Movement of tritium and Cl(-) was studied through undisturbed, unsaturated columns of a Rendoll soil (Eutrochreptic rendoll) containing between 50 and 55% by volume of stones. The columns, 30 cm in diameter and 50 cm long, were leached at a steady flow rate varying from 0.16 to 41 cm/d. Breakthrough curves from these stony soils were smooth and mostly symmetrical, especially for the lowest flux. Based on an analysis with the classical two-parameter convection-dispersion equation, it was found that the dispersion coefficient was linearly related to pore water velocity with an average dispersivity of about 4 cm. The difference between the retardation factors for Cl(-) and tritium averaged 0.16 pore volumes. Using a four-parameter transport equation with exchange between mobile and immobile liquid phases, an immoble water fraction of 15% was found, independent of the leaching rate. The four-parameter model provided no better fit to the experimental data than the two-parameter model for the lowest flux and only slightly better fits for all the other cases. This indicates that nonequilibrium conditions between mobile and immobile phases were of minor importance in modeling solute transport through this stony soil. (Author's abstract)
W87-06796

ESTIMATING THE VARIABILITY OF UNSATURATED SOIL HYDRAULIC CONDUCTIVITY USING SIMPLE EQUATIONS,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
R. J. Wagenet, and T. M. Addiscott.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 42-47, January-February 1987. 3 fig, 3 tab, 15 ref.

Descriptors: *Unsaturated flow, *Soil water movement, *Model studies, *Hydraulic conductivity, *Permeability coefficient, *Mathematical studies, *Soil water, *Moisture content, Equations, Distribution, Estimating.

Description of transient water flow requires knowledge, or estimation, of the relationship between the unsaturated soil hydraulic conductivity, K, and volumetric water content. A variety of studies have related K(theta) to the saturated conductivity K sub 0 by equations involving the volumetric water content, theta, and its value at saturation, theta sub 0. The relationship is expressed here in terms of either the difference between theta and theta sub 0 or the ratio of theta to theta sub 0, so that K(theta) is obtained by multiplying K sub 0 by exp(beta(theta - theta sub 0)) or by (theta/theta sub 0) to the 2b + 3 power respectively, with beta and b being constants for any one sampling point. The quantity beta in the equation involving (theta - theta sub 0) can be obtained from field data by four different mathematical methods. When this equation was used to compute distributions of lnK(theta) from measured distributions of lnK sub 0 and lnbeta, the first four moments of the resulting distributions of lnK(theta) all differed considerably according to the mathematical method used, although K sub 0 and beta were derived in each case from the same set of field data. When both equations were used to estimate lnK(theta), using the same distributions of lnK sub 0 and appropriate distributions of lnbeta or lnb, there were large differences between them in the moments of the resulting distributions. The estimate of lnK(theta) from the equation using theta/theta sub 0 had much the larger variance, mainly because the variance of lnb was about three times that of lnbeta. (Author's abstract)
W87-06797

METHOD OF ESTIMATING THE TRAVEL TIME OF NONINTERACTING SOLUTES THROUGH COMPACTED SOIL MATERIAL,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibiiographic entry see Field 5B.
W87-06798

ALUMINUM SPECIATION: A COMPARISON OF FIVE METHODS,
Clemson Univ., SC. Dept. of Computer Engineering.
For primary bibliographic entry see Field 2K.
W87-06800

PREDICTION OF PH ERRORS IN SOIL-WATER EXTRACTORS DUE TO DEGASSING,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Suarez.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 64-67, January-February 1987. 4 fig, 6 ref.

Descriptors: *Water analysis, *Sampling, *Soil water extractors, *Hydrogen ion concentration, *Model studies, *Carbon dioxide, *Soil water, *Measuring instruments, Precipitation, Prediction, Soil solutions, Performance evaluation, Field tests, Degassing.

Moisture samples taken from the unsaturated zone with soil water extractors undergo degassing and an upward shift in pH. The measured pH values from commercially available extractors are usually sufficiently in error that they cannot be used in a quantitative manner. A model was developed that predicts the extent of CO2 degassing and the resulting pH error. Using this model measured pH values can be corrected back to in situ soil water pH provided that precipitation has not occurred in the extractor. Extractors are classified into two groups-single chamber and multichambered. The extractors are evaluated for both operation under constant vacuum (open to the source) and decreasing vacuum (evacuated and then sealed). Analysis of the data and model predictions indicates that the major factor controlling the pH error is the ratio of liquid volume to total extractor volume. Additional factors exerting major influence are the initial extractor gas composition and the total pressure in the extractor when sampled. Variations in soil solution composition and differences in soil CO2 concentrations in carbonate buffered systems had a major effect on pH values but a negligible effect on the extractor induced pH error. Under typical field conditions the multichambered extractor is predicted to give the most satisfactory results; the pH errors were sufficiently small that no corrections for degassing were necessary. (Author's abstract)
W87-06801

SINGLE COLUMN ION CHROMATOGRAPHY: III. DETERMINATION OF ORTHOPHOSPHATE IN SOILS,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
For primary bibliographic entry see Field 2K.
W87-06802

SENSITIVE COLORIMETRIC METHOD FOR THE QUANTITATION OF SELENITE IN SOIL SOLUTIONS AND NATURAL WATERS,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
For primary bibliographic entry see Field 5A.
W87-06803

EFFECT OF GROWTH RATE ON THE GROWTH OF BACTERIA IN FRESHLY MOISTENED SOIL,
Georgia Univ., Athens. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W87-06804

ESTIMATING AIR POROSITY AND AVAILABLE WATER CAPACITY FROM SOIL MORPHOLOGY,
Department of Agriculture, Ottawa (Ontario).
J. A. McKeague.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 148-152, January-February 1987. 3 fig, 2 tab, 21 ref.

Descriptors: *Calibrations, *Soil morphology, *Soil horizons, *Soil water capacity, *Porosity, Soil physical properties, Estimating, Soil surveys, Pores, Standards.

Field guidelines based on soil morphology and calibrated against measured values were developed for estimating air porosity (AP, volume percent air-filled pores at 5 kPa) and available water capacity (AWC, volume percent water retained between 5 and 1500 kPa). The guidelines were tested by estimating and subsequently measuring these properties of 24 soil horizons. The mean of the absolute differences between estimated and measured AP and AWC were 3.7 and 4.5% respectively. AP for the 24 horizons ranged from 3 to 30% and AWC from 14 to 39%. In view of the magnitude of local soil variability, the discrepancies in measured values of AP and AWC by different methods and the lack of standard methods, the estimates are shown to be useful. Estimation of air-water regime properties of soils from well-calibrated morphological guidelines is recommended for use in soil survey and in research on effects of management on soil physical properties. (Author's abstract)
W87-06805

EFFECTS OF SOYBEAN AND CORN RESIDUE DECOMPOSITION ON SOIL STRENGTH AND SPLASH DETACHMENT,
Missouri Univ.-Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W87-06806

RELATION BETWEEN SOIL PROPERTIES AND EFFECTIVENESS OF LOW-COST WATER-HARVESTING TREATMENTS,
Agricultural Research Service, Tucson, AZ.
For primary bibliographic entry see Field 4B.
W87-06807

SIGNIFICANCE OF SULFIDE OXIDATION IN SOIL SALINIZATION IN SOUTHEASTERN SASKATCHEWAN, CANADA,
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
A. R. Mermut, and M. A. Arshad.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 247-251, January-February 1987. 4 fig, 4 tab, 28 ref.

Descriptors: *Soil chemistry, *Saline soils, *Salinization, *Sulfide oxidation, *Saskatchewan, *Soil solutions, Sulfates, Salts, Salinity, Soil columns, Sulfides, Natrojarosite, Minerals, Anions, Cations, Hydrolysis, Marine shale, Glacial till.

Several deep soil columns in the Weyburn area, Saskatchewan, Canada, show features related to S(2-) oxidation, including the presence of high amounts of SO4(2-) salts and low pH. A soil 4-km west of Cedoux that had 1-m layer of till underlain by Cretaceous marine shale was selected to characterize these features. X-ray diffraction, scanning electron microscope, and chemical techniques confirmed the presence of well-developed crystals of natrojarosite between the 100- to 600-cm depth, and sulfides below 550 cm. Sulfate was the predominant water-soluable anion, with Na(+) followed by Mg(2+) and Ca(2+) as major cations. Accumulation of sulfate in the Cedoux soil and similar soils in the area was attributed to sulfide oxidation and hydrolysis of natrojarosite. Sulfate salts probably are still produced at present. Due to their mobility and recycling in the soils and Cretaceous marine shale it was difficult to bring to light the genesis of salts in Saskatchewan. (Author's abstract)
W87-06808

STOCHASTIC MODELING OF LARGE-SCALE TRANSIENT UNSATURATED FLOW SYSTEMS,
Massachusetts Inst. of Tech., Cambridge.
A. Mantoglou, and L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 37-46, January 1987. 2 fig, 26 ref, append. NSF Grant ECE-8311786 and NRC Contract 03-84-174.

Descriptors: *Model studies, *Unsaturated flow, *Soil properties, *Mathematical equations, *Stochastic process, *Mathematical models, Flow, Equations, Hydraulic conductivity, Permeability

coefficient, Moisture capacity, Soil water, Hysteresis, Anisotropy.

A new framework for modeling large-scale transient unsaturated flow systems in spatially variable soils was proposed in order to overcome the problem of limited information about the local details of spatial soil variability. A stochastic approach, which assumes that local soil properties are realizations of three-dimensional random fields, was followed for derivation of a large-scale model representation (structure). The three dimensionality of the local flow and the nonlinear dependence of the local flow output on the local soil properties are considered. The large-scale model structure was derived by averaging the local governing flow equation over the ensemble of realizations of the underlying soil property random fields. The resulting mean model representation is in the form of a partial differential equation in which averaged or effective model parameters occur. These effective model parameters (i.e., effective hydraulic conductivity and effective specific moisture capacity) were evaluated using a quasi-linearized fluctuation equation and a spectral representation of stationary processes. The large-scale model considers the large scale effects of variations in soil properties and has relatively few parameters. It is concluded that soil property variability produces large-scale hysteresis and anisotropy of the effective parameters. The potential theoretical and practical ramifications of these results in the area of unsaturated flow modeling need to be investigated. The general stochastic modeling framework developed here is applicable not only to unsaturated flow but also to other distributed parameter systems (e.g., saturated flow and transport, geothermal and oil reservoir modeling). (See also W87-06816 and W87-06817) (Author's abstract)
W87-06815

CAPILLARY TENSION HEAD VARIANCE, MEAN SOIL MOISTURE CONTENT, AND EFFECTIVE SPECIFIC SOIL MOISTURE CAPACITY OF TRANSIENT UNSATURATED FLOW IN STRATIFIED SOILS,
Massachusetts Inst. of Tech., Cambridge.
A. Mantoglou, and L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 47-56, January 1987. 6 fig, 1 tab, 12 ref, append. NSF Grant ECE-8311786 and NRC Contract 03-84-174.

Descriptors: *Model studies, *Stochastic process, *Moisture tension, *Soil water, *Moisture content, *Unsaturated flow, *Stratified soil, Mathematical equations, Soil properties, Flow, Anisotropy, Hysteresis, Pores.

The capillary tension head variance, the mean soil moisture content, and the effective specific soil moisture capacity were evaluated for transient unsaturated flow in stratified soils using a three-dimensional stochastic approach. The large difference in the correlation scales in stratified soils simplified the related stochastic equations, allowing for analytical evaluations and derivation of generic expressions. Simplified asymptotic expressions, valid at particular ranges of the soil property and the mean flow characteristics, were also derived. The theoretical results were applied to two real soils. The capillary tension head variance, the mean soil moisture content, and the effective specific soil moisture capacity showed a large-scale hysteresis which is due to spatial variability of the local hydraulic soil properties rather than to hysteresis in the local parameters. A companion paper shows that the effective hydraulic conductivities also show hysteresis produced by spatial soil variability. Such large-scale hysteresis is mathematically, physically, and intuitively plausible. This may suggest that the hysteresis observed in laboratory or field experiments is, at least partly, due to soil variability rather than pore scale effects. This could be anticipated since spatial variability is the rule rather than the exception and it exists even in small-scale experiments. (See also W87-06815 and W87-06817) (Author's abstract)
W87-06816

EFFECTIVE HYDRAULIC CONDUCTIVITIES OF TRANSIENT UNSATURATED FLOW IN STRATIFIED SOILS,
Massachusetts Inst. of Tech., Cambridge.
A. Mantoglou, and L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 57-67, January 1987. 8 fig, 18 ref, append. NSF Grant ECE-8311786 and NRC Contract 03-84-174.

Descriptors: *Moisture tension, *Model studies, *Stochastic process, *Soil water, *Moisture content, *Unsaturated flow, *Hydraulic conductivity, *Permeability coefficient, Stratified soil, Field tests, Comparison studies, Flow, Anisotropy, Hysteresis, Pores.

The effective hydraulic conductivities of transient unsaturated flow in stratified soils were evaluated using a three-dimensional stochastic approach. Because of the disparity of the correlation scales in a stratified soil, the general stochastic equations were simplified, and this allows analytical evaluation and derivation of generic expressions for the effective hydraulic conductivities. Simple asymptotic expressions, valid at particular ranges of the soil property and the mean flow characteristics, were also derived. Several examples illustrating the results using data from two real soils are also presented. The effective hydraulic conductivities showed significant hysteresis and are anisotropic with a degree of anisotropy depending on the mean flow conditions (wetting or drying). Such hysteresis and anisotropy are produced by the spatial variability of the hydraulic soil properties rather than hysteresis or anisotropy of the local parameters. A physical interpretation of the results is given along with a qualitative comparison with field observations. The ramifications of this study need to be further investigated and considered in field applications such as waste disposal control. (See also W87-06815 and W87-06816) (Author's abstract)
W87-06817

DEVELOPMENT AND EVALUATION OF CLOSED-FORM EXPRESSIONS FOR HYSTERETIC SOIL HYDRAULIC PROPERTIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. B. Kool, and J. C. Parker.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 105-114, January 1987. 9 fig, 4 tab, 34 ref.

Descriptors: *Flow models, *Model studies, *Hysteresis, *Soil water, *Soil properties, *Hydraulic conductivity, *Permeability coefficient, Calibrations, Transient flow, Flow, Prediction, Pores, Simulation, Estimating, Infiltration, Drainage.

A concise representation of hysteretic soil hydraulic properties is given based on a combination of M. T. van Genuchten's (1980) parametric K-theta-h model and P. S. Scott et al.'s (1983) empirical hysteresis model modified to account for air entrapment. The resulting model yields compact closed-form expressions for the hysteretic water retention curve theta(h) and soil water capacity C(h), as well as for the hydraulic conductivity function K(h). Depending on the degree of simplification involved, the model entails a total of 6-9 parameters which can be calibrated from direct measurements of theta(h) and saturated conductivity or by an inverse solution approach from transient flow experiments. Comparison of model-predicted and measured K-theta-h relations for eight soils revealed one case in which model predictions were very poor. Model accuracy was judged to be acceptably good in the other cases. Mualem's modified (Y. Mualem, 1984) dependent domain model was found to be more accurate for soils with very narrow pore size distributions. Use of a simplified version of the proposed model with two parameters eliminated provided overall accuracy very similar to that of the more complex model. Numerical simulations of flow during transient infiltration and drainage using the proposed model and a variant of Y. Mualem's (1984) modified dependent domain model did not differ greatly and agreed reasonably well with experimental water content distributions, even when scanning curves were not described very accurately. By contrast, simulations without consideration of hysteresis produced highly unacceptable results. It is concluded that the proposed model provides a convenient and simple means of incorporating hysteretic effects into numerical flow models to provide significant improvement in prediction accuracy with little additional effort and with minimal data requirements. (Author's abstract)
W87-06821

UNSATURATED FLOW IN A CENTRIFUGAL FIELD: MEASUREMENT OF HYDRAULIC CONDUCTIVITY AND TESTING OF DARCY'S LAW,
Geological Survey, Menlo Park, CA.
J. R. Nimmo, J. Rubin, and D. P. Hammermeister.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 124-134, January 1987. 11 fig, 4 tab, 28 ref.

Descriptors: *Centrifuges, *Darcy's law, *Unsaturated flow, *Hydraulic conductivity, *Permeability coefficient, *Steady flow, Soil types, Soil properties, Prediction, Flow, Sand, Gravity.

A method was developed to establish steady state flow of water in an unsaturated soil sample spinning in a centrifuge. Theoretical analysis predicts moisture conditions in the sample that depend strongly on soil type and certain operating parameters. For Oakley sand, measurements of flux, water content, and matric potential during and after centrifugation verify that steady state flow can be achieved. Experiments have confirmed the theoretical prediction of a nearly uniform moisture distribution for this medium and have demonstrated that the flow can be effectively one-dimensional. The method was used for steady state measurements of hydraulic conductivity K for relatively dry soil, giving values as low as 7.6 times 10 to the minus 11th power m/s with data obtained in a few hours. Darcy's law was tested by measuring K for different centrifugal driving forces but with the same water content. For the sand at a bulk density of 1.82 Mg/cu m and 27% saturation, results were consistent with Darcy's law for K equal to 5.22 times 10 to the minus 10th power m/s and forces ranging from 216 to 1650 times normal gravity. (Author's abstract)
W87-06823

DECREASES IN HYDROCARBONS BY SOIL BACTERIA,
Arizona Univ., Tucson. Univ. Analytical Center.
For primary bibliographic entry see Field 5B.
W87-06857

GROUNDWATER PROTECTION BY SOIL MODIFICATION,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5G.
W87-06863

INFLUENCE OF FORMATION CLAYS ON THE FLOW OF AQUEOUS FLUIDS,
Haliburton Services, Duncan, OK.
W. F. Hower.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 117-127, 3 tab, 15 ref, append.

Descriptors: *Clays, *Flow patterns, *Soil water, *Groundwater movement, Permeability damage, Aquifers, Wells, Oil, Fuel, Potassium, Ammonium, Ions, Polymers.

Most sandstone formations contain clays that can have a significant effect on the flow of aqueous fluids. The clays most frequently detected are smectite, mixed layer, illite, kaolinite, and chlorite. All of these clays are capable of migrating and causing permeability damage when they are contacted by waters foreign to the formation. Normally, these waters alter ionic environments around the clays, which causes the clays to be dislodged from their original positions. Thus, any time clay is

present in the rock, it can be assumed that permeability damage can occur. The degree of damage will depend upon the concentration and types of clays present, their relative position in the rock, the severity of the ionic environmental change, and fluid velocity. Aqueous fluids that may be classed as foreign waters are effluents being injected into disposal wells, fresh water storage in underground aquifers, flooding waters used to secondary oil recovery, and waters that may contact hydrocarbon-producing formations during numerous phases in a well's life. Permeability damage has been minimized in oil and gas wells through the use of the potassium and ammonium ions. These ions will control the amount of water adsorbed by clays but, since they are exchangeable, they do not affect permanent protection against clay migration. A hydroxy-aluminum ion has been used effectively for formation treatment, but its use is limited to formation temperatures below 93.3 C (200 F) and where pH values do not vary more than a few integrals from neutral. The most effective material that provides long-time control of clay migration under a large variety of conditions is a select group of organic polymers. These polymers are strongly adsorbed by clays, thus helping to prevent clay movement in the rock matrix. (See also W87-06888) (Author's abstract)
W87-06897

ROLE OF THE UNSATURATED ZONE IN RADIOACTIVE AND HAZARDOUS WASTE DISPOSAL.
For primary bibliographic entry see Field 5E.
W87-06947

NRC-FUNDED STUDIES ON WASTE DISPOSAL IN PARTIALLY SATURATED MEDIA,
Nuclear Regulatory Commission, Washington, DC. Low-Level Waste Licensing Branch.
For primary bibliographic entry see Field 5E.
W87-06948

MODELING OF MOISTURE MOVEMENT THROUGH LAYERED TRENCH COVERS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W87-06949

MODEL TO SIMULATE INFILTRATION OF RAINWATER THROUGH THE COVER OF A RADIOACTIVE WASTE TRENCH UNDER SATURATED AND UNSATURATED CONDITIONS,
Office of Radiation Programs, Washington, DC.
For primary bibliographic entry see Field 5B.
W87-06950

SIMULATION OF THE EFFECTS OF ORGANIC SOLUTES ON THE HYDRAULIC CONDUCTIVITY OF VARIABLY SATURATED, LAYERED MEDIA,
Ertec Western, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5B.
W87-06951

UNSATURATED FLOW IN HETEROGENEOUS SOILS,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, and L. W. Gelhar.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 71-79, 6 fig, 8 ref.

Descriptors: *Unsaturated flow, *Heterogeneous soils, *Soil water, *Illinois, *Permeability coefficient, *Anisotropy, Flow profiles, Hydraulic properties, Mathematical studies, Statistical analysis.

Hydrologists or soil physicists generally assume that soil is homogeneous and isotropic when they deal with unsaturated flow in most field situations. However, several recent studies show that soil hydraulic parameters could vary significantly in the field. For example, the standard deviation of log saturated hydraulic conductivity has been observed in the range between 0.3 and 3.0. Correspondingly, the coefficient of variation is in the range of 0.20 to 90. This simply implies that the spatial variation of soil properties is substantial in the field situation. To illustrate the degree of the spatial variation of the soil hydrologic parameters, the spatial distribution of the permeability of Mt. Simon sandstone in Illinois is shown. As indicated, the permeabilities canbe completely different at distances as small as one foot. The standard deviation of the log saturated hydraulic conductivity is 1.6 in this case. Spatial variation in the porosity also exists. Unsaturated hydraulic conductivity anisotropy is shown to be moisture dependent. Thus, the classic approach to predict flow in unsaturated media may have to be carefully re-examined. This new finding should draw much attention to the anisotropy of unsaturated hydraulic conductivity in the future. Potential application of this anisotropy may be in liquid waste disposal and design of underground storage facilities. However, more field observations and laboratory experiments are needed to substantiate this result. (See also W87-06947) (Lantz-PTT)
W87-06952

ROLE OF PARTIALLY SATURATED SOIL IN LINER DESIGN FOR HAZARDOUS WASTE DISPOSAL SITES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5E.
W87-06953

MOISTURE CHARACTERISTICS OF COMPACTED SOILS FOR USE IN TRENCH COVERS,
Illinois State Geological Survey Div., Champaign.
S. Klein, T. M. Johnson, and K. Cartwright.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 101-111, 8 fig, 1 tab, 11 ref. NRC Contract NCR 02-80-074.

Descriptors: *Infiltration, *Soil water, *Trench covers, *Hydraulic properties, *Compacted soils, *Illinois, *Permeability coefficient, Mathematical studies, Particle size, Capillary water, Capillarity, Hydraulic conductivity.

The hydraulic behavior of unsaturated, compacted, fine-grained materials affects the performance of several types of engineering facilities, such as covers for waste disposal sites, dam cores, and highway subgrades. Unsaturated moisture movement may significantly affect infiltration through trench covers; highway subgrades are also subjected to seasonal temperature or moisture variations. This study investigates the hydraulic conductivity of two geologic materials that are relatively common in central Illinois-windblown silt (loess) and glacial till. The importance of compaction moisture content is illustrated for unsaturated and saturated conditions. The range of capillary pressures investigated was limited to between 0 and 1000 cm of water; the range of capillary pressures commonly observed in the relatively humid eastern part of the United States. It should be noted that observed capillary pressures in arid regions will be much greater. The conclusions presented here will probably also be valid in arid regions, although this was not explicitly shown. (See also W87-06947) (Lantz-PTT)
W87-06954

FIELD EXPERIMENTS TO DETERMINE SATURATED HYDRAULIC CONDUCTIVITY IN THE VADOSE ZONE,
New Mexico Inst. of Mining and Technology, Socorro.
D. B. Stephens, S. Tyler, K. Lambert, and S. Yates.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 113-126, 7 fig, 2 tab, 14 ref. OWRT Project B-073-NMEX.

Descriptors: *Soil water, *Permeability coefficient, *Vadose water, *Saturated soils, *Boreholes, *Infiltration, Flow rate, Capillarity, Carbon dioxide, Field tests, Hydraulic conductivity.

Borehole infiltration tests are widely used by geotechnical engineers to determine the saturated hydraulic conductivity in the vadose zone. The particular borehole test under consideration is one in which a constant head of water is maintained, without pump pressure, in an open borehole until the flow rate becomes steady. A comparison of flow rate and water content data for three tests at one site (S3T), S3T4, S3T6, and S3T7, suggests that air is entrapped during infiltration from the borehole. Flooding the soil with a highly water soluble gas, such as carbon dioxide, prior to the infiltration test seems to be an effective means of removing a significant portion of the entrapped air. Differences in infiltration rates and water contents during the three tests may be explained as follows: During S3T4 the smallest diameter pore spaces contain air entrapped behind a rapidly advancing wetting front. During S3T6 these gas bubbles are replaced with water when the carbon dioxide dissolves. During drainage after S3T6 most of the smallest pores still contain water held by capillary forces. When the water begins to infiltrate again during S3T7, most of the small pores which trapped air during S3T4 are filled with water and only a few remaining pores have structures conducive to air entrappment. The cause of air entrappment in the field may be due in part to the large hydraulic gradients (on the order of 100) imposed on the soil during the rapid filling of the borehole. In the laboratory, the 100 cu cm rings were wetted slowly from below under gradients which were much less than those found in the field. No significant change in hydraulic conductivity was observed after as many as 80 pore volumes of water passed through the laboratory samples. (See also W87-06947) (Lantz-PTT)
W87-06955

COMPOSITION, DENSITY AND FABRIC EFFECTS ON BULKY WASTE CAPILLARY RETENTION CHARACTERISTICS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. E. Veyera, and J. P. Martin.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 127-146, 21 fig, 3 tab, 10 ref.

Descriptors: *Waste disposal, *Soil water, *Soil density, *Capillarity, *Permeability coefficient, Capillary water, Retention capacity, Mathematical studies, Sands, Soil properties, Hydraulic conductivity.

Capillary retention curves are one of the basic data sources used in evaluating hydraulic properties of unsaturated porous media. Parameters such as residual saturation, pore size distribution and displacement pressure head can be determined from such curves. These parameters are used in analyses such as determination of drainable liquid and formulation of unsaturated hydraulic conductivity functions. A laboratory method is presented which rapidly and easily yields capillary retention data for bulky waste materials. The data was generated for remolded samples by controlling composition, density and fabric. Intact field samples were also tested. Test results indicate that uniform clean sand properties do not seem to be particularly sensitive to fabric. Soils having plastic behavior were shown to be very sensitive to fabric. Most waste materials and natural soils would appear to fall in between these two extremes in regard to fabric sensitivity. Capillary retention data generated from these tests provides basic data which isuseful in evaluating the hydraulic properties of unsaturated porous media. (Se ee also W87-06947) (Lantz-PTT)
W87-06956

LABORATORY ANALYSIS OF WATER RETENTION IN UNSATURATED ZONE MATERIALS AT HIGH TEMPERATURE,
Geological Survey, Menlo Park, CA. Water Re-

sources Div.
J. Constantz.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 147-164, 8 fig, 4 tab, 12 ref.

Descriptors: *Hazardous wastes, *Aeration zone, *Temperature effects, *Soil moisture retention, *Radioactive wastes, *Waste disposal, *Mathematical studies, Sand, Laplace equation.

The disposal of high-level radioactive wastes in the unsaturated zone may cause large temperature gradients in the immediate vicinity of the disposal site. Predicting the fate of high temperature wastes necessitates an adequate understanding of heat and mass transfer through the surrounding material. A quantification of the influence of temperature upon water retention characteristics in unsaturated materials is essential for prediction of heat and mass transfer. Previous investigations indicate that the influence of temperature upon water holding characteristics is significant and that additional work is necessary for a more complete understanding of the magnitude of the effect. The purpose of this study is to extend the temperature range investigated and to extend the experimental conditions to incorporate both draining and wetting processes. In the present investigation, the water retention is measured up to 95 C, using a new experimental technique. This technique provides a means of examining the usefulness of applying simple capillary retention theory to pore water retention above 50 C. Three results of these experiments on Tipperary Sand are notable in connection with high temperature water retention characteristics: (1) apparent compaction of the sand samples may have been caused by the high temperature conditions. This suggests that predictions of the physical behavior of unsaturated zone materials in the immediate vicinity of high temperature wastes should consider the effect of compaction of the material in response to thermal loading; (2) the results show that measurably less water is held at high temperature below about 50% saturation than is predicted by a simple capillary retention model; and (3) results indicate that the influence of temperature or gas bubble formation within the pore water system may measurably decrease the water holding capacity of sand at high temperature above 50% saturation. Therefore, failure of the LaPlace equation to predict the effect of temperature above 50 C on water retention may be explained by the inadequacies of a simple surface tension-temperature correction to properly describe capillary retention forces existing at lower values of the pore water matric potential (psi), and the inability of the correction to handle bubble formation at the highest values of psi. (See also W87-06947) (Lantz-PTT)
W87-06957

ROLE OF DESATURATION ON TRANSPORT THROUGH FRACTURED ROCK,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W87-06958

POTENTIAL USE OF GPR IN ASSESSING GROUNDWATER POLLUTION IN PARTIALLY AND FULLY SATURATED SOILS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W87-06959

NUCLEAR WASTE ISOLATION IN THE UNSATURATED ZONE OF ARID REGIONS,
Lawrence Berkeley Lab., CA.
For primary bibliographic entry see Field 5E.
W87-06960

CASE HISTORY STUDY OF WATER FLOW THROUGH UNSATURATED SOIL,
Texas Univ. at Austin. Dept. of Civil Engineering.
S. J. Trautwein, D. E. Daniel, and M. W. Cooper.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 229-253, 11 fig, 9 ref.

Descriptors: *Evaporation ponds, *Seepage, *Permeability coefficient, *Model studies, *Soil water, *Groundwater movement, *Case studies, Flow profiles, Aeration zone, Flow profiles, Leakage, Groundwater pollution, Clay, Hydraulic conductivity.

Evaporation ponds are commonly used in arid regions for the disposal of large amounts of liquid waste. In order to maximize evaporation, the ponds are generally shallow (only one to three feet deep) and are constructed to cover large areas. Seepage from evaporation ponds has not usually been a major concern. Besides locating ponds at sites with clayey soils, little additional effort has usually been made to control leakage. Presently, however, due to increased awareness of possible damage to the environment and stricter government regulations concerning the pollution of groundwater, special design considerations are needed to control seepage from these ponds. Many newly constructed ponds are required to be lined with compacted clay or a synthetic material. In addition, some type of leak detection system is generally required to monitor the quality of groundwater in the vicinity of a pond. Monitor wells are most commonly used for this purpose. Seepage from the ponds studied occurred at a much faster rate than expected. This is in agreement with general experience obtained recently on other projects where the actual field value of hydraulic conductivity was an order of magnitude or more larger than values measured in the laboratory. Macroscopic features such as cracks, root holes, and fissures probably control the rates of seepage in the field, but these features are difficult to account for in laboratory tests. The large differences between laboratory values of hydraulic conductivity and values back-calculated from the analyses emphasize the importance of calibrating numerical models with known field behavior. This case history also provided the opportunity to determine if flow at a complex site could be simulated with a numerical model. The results obtained for the simplified problem seem reasonable even though there were significant uncertainties in some of the soil properties. The ability of the model to simulate two different known flow conditions increased the level of confidence in predictions obtained for future patterns of migration. The single most important parameter that influenced the predicted results wassaturated hydraulic conductivity. (See also W87-06947) (Lantz-PTT)
W87-06962

HYDROLOGIC STUDY OF THE UNSATURATED ZONE ADJACENT TO A RADIOACTIVE WASTE DISPOSAL SITE AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
Environmental Resources Management, Inc., West Chester, PA.
P. Gruber.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 255-287, 10 fig, 22 ref.

Descriptors: *Hazardous wastes, *Geohydrology, *Path of pollutants, *Waste disposal, *Disposal sites, *Aiken, *South Carolina, *Savannah River Plant, *Radioactive wastes, Groundwater movement, Stratigraphy, Monitoring, Soil horizons, Permeability coefficient, Soil water, Hydraulic conductivity.

This paper was prepared as a description of work sponsored by the United States Energy Research and Development Administration through a Laboratory Graduate Participation Appointment awarded under its contract with Oak Ridge Associated Universities. Field work for this project was completed in August 1976 at the Savannah River Plant and Savannah River Laboratory, Aiken, South Carolina. Disposal facilities of low-level solid radioactive wastes in the form of landfills or burial grounds is a major concern to those generating these wastes as well as state compacts involved in the development of new sites. In order to monitor and predict the movement of radioactive nuclides in the environment, if leakage of radioactive materials from a disposal site should occur, data must be collected to meet specific objectives. These objectives include: (1) a definition of the geometry and geology of the disposal site; (2) an evaluation and description of the regional geologic and tectonic environment of the study area to include its lithology, stratigraphy, structure, and seismicity; (3) an evaluation and description of the regional groundwater flow system underlying the disposal site including, groundwater flow rates and direction, hydraulic conductivities, and recharge rates; (4) an evaluation of the relationship of groundwater to surface water, and (5) an evaluation of the nature of the interaction of radioactive nuclides with the soils at the disposal site. Several observations can be made about the spatial variability of the physical properties of the soil in the study area and the burial grounds. Two distinctive, well defined horizons exist in the soils in the study area at depths of 12 to 24 inches and below 130 inches. These clay-rich and compacted horizons inhibit the movement of soil water. Hydraulic conductivity graphed as a function of percent saturation decreases with depth throughout the profile. Soil water flux decreases with depth and time following steady-state infiltration, and soil water storage at depths exceeding 90 inches increases with depth and time after an initial period of drainage. (See also W87-06947) (Lantz-PTT)
W87-06963

GEOLOGIC CHARACTER OF TUFFS IN THE UNSATURATED ZONE AT YUCCA MOUNTAIN, SOUTHERN NEVADA,
Geological Survey, Denver, CO.
R. B. Scott, R. W. Spengler, S. Diehl, A. R. Lappin, and M. P. Chornack.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 289-335, 18 fig, 2 tab, 41 ref.

Descriptors: *Model studies, *Soil water, *Groundwater recharge, *Aeration zone, *Yucca Mountain, *Nevada, *Geohydrology, Radioactive wastes, Waste disposal, Porosity, Stratigraphy, Flow profiles.

At Yucca Mountain, a potential site for a high-level nuclear waste repository on the Nevada Test Site in southern Nevada, evaluation of the geologic setting and rock physical properties, along with previous regional hydrologic studies, has provided background that can be used for construction of a preliminary conceptual hydrologic model of the unsaturated zone. The 500-m-thick unsaturated portion of Yucca Mountain consists of alternating layers of two contrasting types of tuff. One type consists of highly fractured, densely welded, relatively nonporous but highly transmissive ash-flow tuffs. The other type consists of relatively unfractured, nonwelded, highly porous but relatively nontransmissive, argillic and zeolitic bedded tuffs and ash-flow tuffs. The contrast between these two sets of distinctive physical properties results in a stratified sequence best described as 'physical-property stratigraphy' as opposed to traditional petrologic stratigraphy of volcanic rocks. The vast majority of recharge through the unsaturated zone is assumed to be vertical; the dominant migration may occur in fractures of densely welded tuffs and in the matrix of nonwelded tuff, but the mode of fluid flow in these unsaturated systems is undetermined. Limited lateral flow of recharge may occur at horizons where local perched water tables may exist above relatively nontransmissive zeolitized nonwelded tuffs. The pervasive north-northwest-striking fractures may control the direction of lateral flow of recharge, if any, in the unsaturated zone, and certainly that direction coincides closely with the observed south-easterly flow direction in the saturated zone under Yucca Mountain. Empirical evaluation of this conceptual hydrologic model has begun. (See also W87-06947) (Lantz-PTT)
W87-06964

FIELD-SCALE EVALUATION OF INFILTRATION PARAMETERS FROM SOIL TEXTURE FOR HYDROLOGIC ANALYSIS,

Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
E. P. Springer, and T. W. Cundy.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 325-334, February 1987. 5 fig, 9 tab, 33 ref.

Descriptors: *Soil physical properties, *Hydrologic aspects, *Infiltration, *Soil texture, *Hydraulic models, *Model studies, Mathematical models, Mathematical equations, Mathematical studies, Prediction, Comparison studies, Field tests, Simulation, Agricultural hydrology, Statistical analysis, Model testing, Surface runoff, Runoff, Overland flow, Flow.

Recent interest in predicting soil hydraulic properties from simple physical properties such as texture has major implications in the parameterization of physically based models of surface runoff. Soil hydraulic parameters predicted from texture were compared on a field scale to those derived from field measurements and simulated overland flow response using these two parameter sets was also compared. The parameters for the Green-Ampt infiltration equation were obtained from field measurement and use of texture-based predictors for two agricultural fields, which were mapped as single soil units. Results of the analysis were that (1) the mean and variance of the field-based parameters were not preserved by the texture-based estimation procedures, (2) spatial and cross correlations between parameters were induced by the texture-based estimation procedures, (3) the overland flow simulations using texture-based parameters were significantly different from those from field-based parameters, and (4) simulations using field-measured hydraulic conductivities and texture-based storage parameters were very close to simulations using only field-based parameters. (Author's abstract)
W87-07112

ONE-DIMENSIONAL QUASI-LINEAR INTERCEPT ON CUMULATIVE INFILTRATION GRAPHS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
G. J. Weir.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 335-341, February 1987. 5 fig, 4 ref.

Descriptors: *Infiltration, *Infiltration rate, *Theoretical analysis, Graphical analysis, Graphical methods, Mathematical equations, Mathematical studies, Groundwater, Groundwater movement, Soil properties, Flow, Permeability, Capillary water, Transient flow equations, Cumulative infiltration, Soil physical properties.

The asymptotic time behavior of one-dimensional infiltration of water into a class of idealized soils is determined theoretically. First, all flows were assumed to be one-dimensional to investigate transient behavior between a steady initial state and another final steady state. Second, soil properties are idealized by making the quasi-linear assumption of J. R. Philip that relative permeability is related exponentially to capillary pressure, which linearizes the flow terms. Third, and least importantly, the changes in volumetric water content were assumed to vary as a power of relative permeability. The transient flow equations then reduce to a nonlinear parabolic equation with relative permeability as the primary variable. One-dimensional cumulative infiltration is then asymptotically a linear function of time, whose gradient depends on the saturated soil conductivity and whose intercept equals the change in field capacity (or near the surface volumetric water content) divided by the quasi-linear inverse length parameter. The equations for both the gradient and intercept for this asymptotic linear function are independent of time and independent of the relationship between volumetric water content and relative permeability. Finally, the three assumptions above imply that the time constant, representative of the duration needed to attain near steady conditions, essentially equals the sum of a term independent of the initial conditions, plus a term depending only on differences between the initial and final conditions. (Author's abstract)
W87-07113

PORE WATER UPAKE BY AGRICULTURAL RUNOFF,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07121

PREDICTING THE WATER-RETENTION CURVE FROM PARTICLE-SIZE DISTRIBUTION: 1. SANDY SOILS WITHOUT ORGANIC MATTER,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
R. Haverkamp, and J.-Y. Parlange.
Soil Science SOSCAK, Vol. 142, No. 6, p 325-339, December 1986. 10 fig, 2 tab, 27 ref, append.

Descriptors: *Mathematical models, *Soil water potential, *Soil water retention, *Soil properties, *Retention, *Planning, Sandy soil, Mathematical equations, Particle size, Hysteresis.

The authors present a simple model for predicting the water-retention characteristics of sandy soils from routinely available soil properties. On the basis of shape similarity between the retention curve h(theta) and the cumulative particle-size distribution function F(d) an analytical expression for h(theta) is derived, following the Brooks and Corey equation, and taking into account air entrapment and hysteresis. Except for water content at natural saturation, which is used as an independent parameter, the operation parameters of the model are obtained directly from F(d) and dry bulk density. The results obtained for 10 sandy soils available from laboratory and field experiments show an excellent agreement between predicted and experimental h(theta) curves. The errors introduced by the prediction model are of the same order of magnitude as the experimental errors of h(theta). Only sandy soils without organic matter are considered here. More general classes of soil will be treated in a subsequent paper. (See also W87-07137) (Author's abstract)
W87-07136

DYNAMICS OF PARTIAL ANAEROBIOSIS, DENITRIFICATION, AND WATER IN A SOIL AGGREGATE: EXPERIMENTAL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Theoretical Production Ecology.
P. A. Leffelaar.
Soil Science SOSCAK, Vol. 142, No. 6, p 352-366, December 1986. 7 fig, 3 tab, 57 ref.

Descriptors: *Denitrification, *Simulations, *Aggregates, *Anaerobic conditions, *Anaerobiosis, *Model studies, *Measuring instruments, Respiration, Hysteresis, Performance evaluation, Soil dynamics.

A respirometer system was developed to study the dynamics of partial anaerobiosis and denitrification in unsaturated soil. The system permits simultaneous measurement of the distribution of water, oxygen, nitrate, ammonium, and pH as a function of space and time in an unsaturated, artificially made, homogeneous, cylindrical aggregate. Changes in atmospheric composition as a function of time in the chamber containing the aggregate can also be measured. Except for water transport, these processes are caused by microbial activity, since roots are not present in the aggregate. The system was specially designed to generate coherent data sets to evaluate a simulation model that calculates the development of denitrification products as a function of environmental conditions. Data were collected via gamma-ray attenuation, gas chromatography, polarography, and chemical analysis of the soil. The experiment showed that hysteresis in the soil water characteristic strongly affects water distribution in the aggregate. Oxygen supply to the aggregate interior is decreased so much that anaerobiosis is maintained in the interior after the oxygen is consumed. Assessment of denitrification through the measurement of nitrate alone will overestimate nitrogen losses, while measurement of nitrous oxide and molecular nitrogen will cause underestimation. The consumption rate of oxygen and the production rates of CO2, nitrous oxide, and molecular nitrogen compare well with field data. This results from pretreatment of the soil, which aimed at avoiding the flush of microbial activity upon wetting. The results support the thesis that denitrification will occur in soil when at a certain place and time oxygen is absent and bacteria capable of denitrification, and water, nitrate, and decomposable organics are present. The respirometer system yields valuable data to evaluate the simulation model. However, full account of the interrelationships among the generated data can be achieved only by the model itself, since the measured variables reflect the integrated effect of biological activity and transport processes. The respirometer system and its measuring devices are described, and some measurements are reported. (Author's abstract)
W87-07137

INFLUENCE OF SELECTED PHYSICAL VARIABLES OF SOILS IN THE NTUZE CATCHMENT ON THE INFILTRATION CAPACITY (ZULULAND COASTAL ZONE) (DIE INVLOED VAN SEKERE GRONDFISIESE VERANDERLIKES OP INFILTRASIEVERMOE IN DIE NTUZE-OPVANGGEBIED (ZOELOELANDSE KUSSTROOK)),
Zululand Univ., Empangeni (South Africa).
G. J. Mulder, and H. J. von M. Harmse.
Water S. A. WASADV, Vol. 13, No. 1, p 43-48, January 1987. 2 fig, 3 tab, 16 ref.

Descriptors: *Infiltration, *Infiltration capacity, *Soil structure, *Soil water, *Zululand, Soil porosity, Soil horizons, Organic compounds, Coasts.

The possible use of various physical parameters (manifested in different soil series (South African Binomial system) and hydrological soil groups (Soil Conservation Services runoff model)) was investigated for use in predicting stabilized infiltration capacity (f sub c) after prolonged accumulation of soil moisture. The results obtained indicated poor to moderate correlations (99% significance level) between the logarithmic transformations of f sub c and soil physical parameters (water content at various depths, texture, organic matter, porosity). The best independent variables for predicting f sub c were (in order of importance): the percentage of pores of <0.03 mm diameter in the A horizon, organic matter of the A horizons, and clay content of B horizons. No significant correlations (95% level) were found between experimentally determined minimum infiltration capacities and soil series or hydrological soil groups (as predicted by the SCS model) of the Zululand catchments. Better results for this region could have possibly been obtained if texture and degree of compaction of A horizons, giving an indirect indication of the micropore content, had been considered through further differentiation of the soil series into phases. (Author's abstract)
W87-07154

CAPILLARY MOISTURE FLOW AND THE ORIGIN OF CAVERNOUS WEATHERING IN DOLERITES OF BULL PASS, ANTARCTICA,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
J. L. Conca, and A. M. Astor.
Geology GLGYB, Vol. 15, No. 2, p 151-154, February 1987. 4 fig, 13 ref. NSF Grants DPP-8215121 and DPP-8206391.

Descriptors: *Weathering, *Flow pattern, *Permeability, *Mathematical models, *Model studies, Computers, Graphical methods, Porosity, Antarctica.

Flow of water through joint blocks that exhibit cavernous weathering was modeled for the Ferrar dolerite in Bull Pass, Antarctica. A peculiar moisture regime allows an analytical solution under steady-state, saturated conditions. The presence of surface coatings on the top surface of the blocks causes the matric potential gradient within the blocks to be horizontal near the surface, deflecting the flow of migrating water toward the uncoated

sides during evaporation. Because weathering of the rock interior is proportional to the moisture flux, the extent of rock weathering will be similar along similar contours of the matric potential gradient. As granular disintegration occurs, it will also follow the lines of equipotential, and cavernous weathering will result if those lines are concave. A computer-generated graphical representation of the flow through these rocks is included. (Author's abstract)
W87-07162

PREPLANTING SOIL MOISTURE USING PASSIVE MICROWAVE SENSORS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W87-07176

PREDICTING IONIC STRENGTH FROM SPECIFIC CONDUCTANCE IN AQUEOUS SOIL SOLUTIONS,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 2K.
W87-07222

SOIL SYSTEMS,
Binnie and Partners, Lima (Peru).
For primary bibliographic entry see Field 5B.
W87-07237

STATISTICAL EVALUATION OF HYDRAULIC CONDUCTIVITY DATA FOR WASTE DISPOSAL SITES,
Neyer, Tiseo and Hindo, Ltd.
W. R. Bergstrom, and G. R. Kunkle.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 81-104, 11 fig, 3 tab, 10 ref.

Descriptors: *Statistical analysis, *Groundwater movement, *Hydraulic properties, *Permeability coefficient, *Waste disposal, *Michigan, Disposal sites, Hydraulic conductivity, Probability distribution, Model studies.

Hydraulic conductivity, or permeability, is a performance-related characteristic of natural soils that is widely used to evaluate site suitability for the containment of waste materials. Many governmental agencies, ranging from local to state and federal units, require the determination of hydraulic conductivity for evaluating waste disposal sites in natural soils. For this reason, substantial hydraulic conductivity data was obtained during the investigation of eight existing or proposed waste disposal sites in Michigan. As many as 28 conductivity tests were performed on soil samples from a single site. Due to the volume of hydraulic conductivity test data, a statistical approach was judged appropriate for analysis of the results. Results indicated that: (1) the conductivity values obtained from one-dimensional consolidation tests probably did not represent exactly the same population of hydraulic conductivity; (2) a range of values for the estimated coefficient of variation for hydraulic conductivity was established. This range of coefficients can be applied, for preliminary estimating purposes, to investigations undertaken with similar techniques to soil deposits similar in nature and origin; and (3) the test data at each site was found to result in a distribution which reasonably approximates a log-normal probability distribution function. Knowledge that the lognormal probability distribution function is a reasonable model for these test programs resulted in the ability to more closely estimate the mean hydraulic conductivity for each site. (See also W87-07243) (Lantz-PTT)
W87-07252

SOIL WATER MODELLING,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
R. J. Hanks.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 15-36, 12 fig, 2 tab, 19 ref.

Descriptors: *Soil water, *Model studies, *Groundwater movement, *Hydrologic models, Computer models, Water storage.

Soil water modelling has received much emphasis in recent years because of the possibility, with the aid of computers with ability to compute fast and large quantities of data, of considering the simultaneous influence of the many factors that influence soil water. Soil water storage is influenced by many external factors in addition to inherent soil properties. Soil properties such as texture, structural stability, etc. can be used to predict the potential reaction of the soil to idealized conditions but many other factors influence the actual soil water situation at any time or place. Climatic factors influence the amount of water to the atmosphere as evaporation or transpiration from plants. Plant factors such as surface cover influence the proportion of evaporation to transpiration. Plant rooting also influences the soil volume from which water can be extracted for transpiration. In addition, hydrologic factors such as size, slope and aspect of the watershed influence runoff or runon of surface water as well as potential evapotranspiration. Management factors also greatly influence soil water through irrigation, removal of plant material, planting crops at different dates, tillage, grazing, etc. Without a model it is next to impossible to estimate the influence of any one factor on soil water properties since so many other factors may have an influence on the results. Use of soil water models, however, allows the prediction of the influence of one or a combination of factors on soil water. While soil water modelling is well advanced and very useful, it is an ongoing process with a wide variety of models available because of a lack of knowledge and the compromise that is always made between practicality, data availability, and answer desired. Several levels of models are discussed which illustrate this point. (See also W87-07346) (Lantz-PTT)
W87-07348

REMOTE SENSING OF SOIL MOISTURE,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
T. Schmugge.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 101-124, 15 fig, 2 tab, 21 ref.

Descriptors: *Remote sensing, *Soil water, *Microwaves, Electromagnetic waves, Radiation, Absorption, Measuring instruments, Sensors.

The microwave portion of the electromagnetic spectrum offers potential for monitoring several of these parameters, and in particular the one which is the subject of this chapter, soil moisture. For the purposes of this chapter, the wavelength range from 0.3 cm to 50 cm is considered to be the microwave portion of the spectrum and for soil moisture sensing only those wavelengths longer than about 5 cm are particularly effective. The placement of microwaves in the electromagnetic spectrum is illustrated. By looking at the atmospheric transmissivity, an advantage of the microwave wavelengths for remote sensing become obvious. There is very little atmospheric absorption of radiation at these wavelengths; thus, observations of the earth's surface can be made from aircraft or satellite altitudes with little or no atmospheric obscuration. Electromagnetic radiation at these wavelengths is particularly effective for soil moisture sensing because of the large contrast between the dielectric properties of liquid water and those of dry soil. The large dielectric constant of water results from the alignment of the permanent electric dipole moment of the water molecule. The dielectric constant of water at the lower microwave frequencies is approximately 80 compared with 3 to 5 for dry soils; as a result, the dielectric constant of wet soils can reach values of 20 or more. This produces a range of soil emissivity from about 0.95 for dry soils to 0.6 or less for wet soils with changes of a corresponding magnitude in the soil's reflectivity. This chapter shows how this change in the soil's dielectric properties can be detected by microwave sensors and used to observe soil moisture variations. This sensitivity has been observed by microwave sensors operating from tower, aircraft and satellite platforms. Discussed is the operation of two types of microwave sensors, passive (radiometers which measure the thermal emission from the ground at microwave wavelengths) and active (radars which transmit a pulse of electromagnetic energy and then measure the back-scattered return). (See also W87-07346) (Lantz-PTT)
W87-07351

TILLAGE-RESIDUE EFFECTS ON SNOW COVER, SOIL WATER, TEMPERATURE AND FROST,
Agricultural Research Service, Morris, MN.
G. R. Benoit, S. Mostaghimi, R. A. Young, and M. J. Lindstrom.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 473-479, March-April 1986. 12 fig, 3 tab, 19 ref.

Descriptors: *Soil water, *Snow accumulation, *Tillage effects, *Frost, *Soil temperature, Residue cover, Corn, Planting management, Agriculture.

A study was conducted to determine the effect of various tillage-residue management systems on snow accumulation, soil water, soil temperature and frost behavior. The treatments consisted of four replications of three tillage methods (fall-plow, fall-chisel and no-till) each with and without residue. All plots were planted to continuous corn. Measurements consisted of weekly determinations of snow depth, soil water content from 0-to 1.4-m depth, soil temperature at 0.5-, 0.10- and 0.30-m, and frost depth. The data show that over-winter tillage-residue effects can have a marked influence on conditions found at spring planting. In general, reduced tillage with residue causes increased snow accumulation which results in reduced frost, earlier frost disappearance and warmer early spring soil temperature. More intense tillage operations resulted in less snow accumulation, deeper frost, greater water accumulation, colder soils and later disappearance of frost in the spring. The implication is that management of tillage-residue interactions might possibly promote earlier planting and may offer a way to enhance some types of agricultural production. (Author's abstract)
W87-07454

DETERMINATION OF GREEN-AMPT PARAMETERS USING A SPRINKLER INFILTROMETER,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W87-07458

INTERNAL DRAINAGE OF FINE-TEXTURED ALLUVIAL SUBSOILS IN NORTH DAKOTA,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
E. J. Doering, L. C. Benz, and G. A. Reichman.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 517-521, March-April 1986. 4 fig, 3 tab, 9 ref.

Descriptors: *Drainage patterns, *Soil water, *Irrigation, *Alluvial soil, Flow, Evaporation, Drainage, Permeability, Hydraulic conductivity, North Dakota.

To evaluate drainage criteria for supplemental irrigation of medium- and fine-textured alluvial soil in semiarid and subhumid regions, a vertical-flow experiment was conducted on 36, natural soil monoliths that had slowly permeable subsoil (barrier) below an average depth of 1.5 m. Each monolith was 2.5 m square and 2.3 m deep. Horizontal flow was eliminated by encasing the monolith in a 30-mil plastic membrane that was sealed into the slowly permeable layer with concrete. Evaporation was eliminated with plastic covers, and 918 mm of water was applied at an average rate of 13.6 mm/day. About 250 mm of applied water were stored in the profile, and the remaining 668 mm drained through the barrier in about 58 days. Therefore, these soils are vertically drainable. Measured hydraulic conductivity (HC) values were not uniform for the 36 monoliths; but saturat-

ed HC values obtained from laboratory measurements on 75-mm diameter cores collected from three locations within the plot area were much more variable than comparable values of the monoliths. Average HC decreased about ten-fold as soil suction increased from near zero to about 4.9 kPa (50 cm of water). (Author's abstract)
W87-07461

DIRECT COMPARISON OF KINETIC AND LOCAL EQUILIBRIUM FORMULATIONS FOR SOLUTE TRANSPORT AFFECTED BY SURFACE REACTIONS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W87-07474

STOCHASTIC THEORY OF FIELD-SCALE FICKIAN DISPERSION IN ANISOTROPIC POROUS MEDIA,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5B.
W87-07475

CHANNEL MODEL OF FLOW THROUGH FRACTURED MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5B.
W87-07476

LONGEVITY AND EFFECT OF TILLAGE-FORMED SOIL SURFACE CRACKS ON WATER INFILTRATION,
South Dakota State Univ., Brookings. Dept. of Plant Science.
E. M. White.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 5, p 344-347, September-October 1986. 2 fig, 4 tab, 8 ref.

Descriptors: *Runoff, *Soil surfaces, *Cracks, *Infiltration, *Tillage, *Drying, *Range management, Drought, Soil water, Soil-water-plant relationships, Crop production, Roots, Soybeans, Oats, Corn.

Ripping on the contour in rangeland creates parallel voids that reform as desiccation cracks to intercept overland flow and reduce runoff. Voids to simulate contour ripping were formed with a spade or coulters in corn, soybean, oat, and fallow plots to determine if ripping would increase water infiltration on isolated sloping areas in larger, nearly level fields. In late summer, infiltration was found to be greater in the area where there was a void than in adjacent areas. Desiccation cracks reformed in the void area as the soil dried, even after corn and soybean plots had been rototilled, except in one year after the soil was nearly saturated with water. Parallel sets of voids spaced 50 cm apart tended to reform as desiccation cracks more readily in corn and soybeans than if the spacing were at 25 or 100 cm. Voids reformed in oats regardless of the spacing. The water content in late summer tended to be greater in the soil with the void than in adjacent soil. (Author's abstract)
W87-07564

EFFECTS OF SEASON AND MANAGEMENT ON THE VANE SHEAR STRENGTH OF A CLAY TOPSOIL,
Agricultural Research Council, Wantage (England). Letcombe Lab.
For primary bibliographic entry see Field 8D.
W87-07580

2H. Lakes

HYPOTHESIZED RESOURCE RELATIONSHIPS AMONG AFRICAN PLANKTONIC DIATOMS,
Michigan Univ., Ann Arbor. Dept. of Biological Chemistry.
P. Kilham, S. S. Kilham, and R. E. Hecky.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1169-1181, November 1986. 3 fig, 74 ref.

Descriptors: *Limnology, *Diatoms, *Lakes, *Nutrients, *Light intensity, *Silicon, *Phosphorus, Plankton, Paleoclimatology, Growth, Pores, Africa.

Several hypotheses were advanced for resource relationships among planktonic diatoms in African freshwater lakes that are consistent with the light and nutrient conditions of the lakes and the extant and fossil distributions of the diatom species in them. The hypotheses are all testable and are potentially powerful tools for interpreting past climatic conditions. A ranking was proposed along a Si:P gradient: at the high end are the planktonic Synedra spp. with the highest Si requirements and lowest P requirements (high Si:P), the planktonic Nitzschia spp. are intermediate, and the Stephanodiscus spp. are at the low end with the lowest Si requirements and highest P requirements (low Si:P). Melosira species may be ranked along a light:P gradient. It is suggested that Melosira distans and Melosira ambigua grow under high light and have low P requirements, Melosira agassizii and Melosira granulata are intermediate, and Melosira nyassensis has the lowest light and highest P requirements. There also appears to be a relationship between pore size and the light regime for growth among the Melosira species; thus, M. distans and M. ambigua have the smallest pores and highest light requirements, M. nyassensis has the largest pores and lowest light requirements. Melosira granulata is intermediate and seems to be very variable in pore size, depending on the light environment. One diatom, Nitzchia fonticola, lives in and on colonies of Microcystis and is considered to be an obligate nitrogen heterotroph. (Author's abstract)
W87-06672

TESTS OF AN EXTENSION TO INTERNAL SEICHES OF DEFANT'S PROCEDURE FOR DETERMINATION OF SURFACE SEICHE CHARACTERISTICS IN REAL LAKES,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
U. Lemmin, and C. H. Mortimer.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1207-1231, November 1986. 18 fig, 4 tab, 41 ref.

Descriptors: *Limnology, *Model studies, *Seiches, *Wind-driven currents, *Model testing, *Stratified lakes, *Defant's method, Prediction, Simulation, Water currents, Rotation, Computers, Lake basins, Lakes.

The success of A. Defant's method of calculating surface seiche periods and structures in real lakes is well known. To test whether it can be adapted and applied with similar success in studies of internal seiches in stratified lakes, in which density structure is simulated by two homogeneous layers, predictions of a computerized version of Mortimer's modified Defant procedure are compared to observations of internal seiche motion in eight lake basins and (in three examples) against the results of more elaborate models. The acceptably close agreement inspires confidence that the modified method is useful for practical predictions which, although approximate, described the principal characteristics of the often large water mass displacements and oscillations. Through their influence on mixing and dispersal, those motions profoundly affect the chemical and biological economies of many lakes. To aid in microcomputer and even pocket calculator applications, we set out steps in the calculation in tabular flow-chart form. A comparable table for surface seiche calculation is added. The procedure is not applicable to large lakes in which effects of the earth's rotation are dominant; but for the two largest basins tested here (Leman and Ness) a modification is introduced to take approximate account of rotation. (See also W87-06674) (Author's abstract)
W87-06673

WIND-INDUCED INTERNAL SEICHES IN LAKE ZURICH OBSERVED AND MODELED,
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
W. Horn, C. H. Mortimer, and D. J. Schwab.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1232-1254, November 1986. 13 fig, 2 tab, 31 ref.

Descriptors: *Limnology, *Model studies, *Seiches, *Wind-driven currents, *Wind effects, *Lake Zurich, *Water currents, Temperature, Lakes, Prediction, Topography, Thermocline, Rotation.

During August and September 1978, 31 current meters and 120 temperature sensors were deployed to record every 10 or 20 min at various depths at 12 moorings (with wind speed and direction at three moorings) in Lake Zurich. We explore here the baroclinic (internal seiche) response to wind impulses, observed as fluctuations in isotherm depth and current speeds. Those fluctuations and their energy spectra are compared with the predictions of two models fitted to basin topography and to the observed average thermal structure: a two-layered variable-depth (TVD) model developed by D. J. Schwab, fitted to basin topography and incorporating a two-dimensional horizontal grid, and C. H. Mortimer's two-layered modification of a simpler procedure originally developed for surface seiche calculations by A. Defant. The dominant responses to wind impulses were internal seiches of the first longitudinal mode (average period 44 h). Weaker signals from the second (24 h) and third (17 h) modes were also seen in spectra of temperature and current fluctuations. The models displayed patterns of thermocline displacement and current which, in periodicity and structure, were closely similar to those observed. Predictions of the Defant model were less precise, particularly for current. Founded on linear theory and neglecting the effects of rotation, the models were unable to reproduce two features occasionally seen in the lake motions: clockwise or anticlockwise rotation of current direction; and internal surges arising when storms induced large-amplitude downstrokes of the thermocline at one basin end or the other. The lake's internal response was principally dependent on the timing, strength, and duration of the wind impulse, relative to and interacting with internal seiche motions already in progress. (See also W87-06673) (Author's abstract)
W87-06674

CURRENTS IN LAKE GENEVA,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
M. Bohle-Carbonell.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1255-1266, November 1986. 9 fig, 14 ref.

Descriptors: *Wind-driven currents, *Water currents, *Lake Geneva, *Wind effects, Gravity waves, Rotation, Lakes, Limnology.

The first synoptic measurements of currents and temperatures in Lake Geneva and the wind field on its shoreline were analyzed to derive mean characteristics of the internal motions. The observations cover the periods from October to March of 1981/1982, 1982/1983, and 1983/1984. The lake responds to a very inhomogeneous diurnal and gradient wind field with high-energy, statistically nonstationary fluctuating currents superimposed on a weak mean state. Current fluctuations of periods between 24 and 12 h appear to propagate cyclonically. Clockwise-turning current vectors, mainly at near-internal frequencies, and a tendency to high energy at low frequencies at nearshore locations are found. Only a portion of the observed details can be explained by features of gravity waves modified by rotation. (Author's abstract)
W87-06675

MICROBIAL CONSUMPTION OF NITRIC AND SULFURIC ACIDS IN ACIDIFIED NORTH TEMPERATE LAKES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. M. Rudd, C. A. Kelly, V. St. Louis, R. H. Hesslein, and A. Furutani.

Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1267-1280, November 1986. 6 fig, 5 tab, 36 ref. NSERC (Canada) Grant A2671.

Descriptors: *Fate of pollutants, *Sulfuric acid, *Limnology, *Acid rain, *Acid lakes, *Lake sediments, *Biodegradation, *Nitric acid, Alkalinity, Bacteria, Inhibition, Lakes, Denitrification, Sulfate reduction, Seasonal variation, Sediments.

Rates of sulfate reduction and denitrification were measured in the sediments of unacidified, experimentally acidified, and atmospherically acidified lakes in North America and Norway. These data, plus profiles of porewater and sediment chemistry, demonstrated that in all of the lakes H(+) was being actively consumed by both sulfate reducers and denitrifiers. Both of these microbial activities were assayed in sediments overlaid by oxygenated water, demonstrating that anoxic hypolimnia are not required for in situ alkalinity production. Neither short term experimental acidification nor long term atmospheric acidification had detectably inhibited the activity of these two types of bacteria. Both processes were active at pH 4.5. In lakes that were receiving significant quantities of both nitric and sulfuric acids, short term H(+) consumption from denitrification was 1.5-2 times faster than H(+) consumption by sulfate reduction. However on an annual basis, because of loss of reduced sulfur during fall and winter, long term H(+) consumption by denitrification was estimated to be 4-5 times as large as H(+) consumption by sulfate reduction. (See also W87-06677) (Author's abstract)
W87-06676

ROLE OF SULFATE REDUCTION IN LONG TERM ACCUMULATION OF ORGANIC AND INORGANIC SULFUR IN LAKE SEDIMENTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W87-06677

TIME RESOLUTION METHODOLOGY FOR ASSESSING THE QUALITY OF LAKE SEDIMENT CORES THAT ARE DATED BY 137CS,
Department of Energy, New York. Environmental Measurements Lab.
For primary bibliographic entry see Field 5B.
W87-06678

LITTLEFIELD LAKE, MICHIGAN: CARBONATE BUDGET OF HOLOCENE SEDIMENTATION IN A TEMPERATE-REGION LACUSTRINE SYSTEM,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
N. M. Dustin, B. H. Wilkinson, and R. M. Owen.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1301-1311, November 1986. 8 fig, 5 tab, 23 ref. NSF Grant EAR 78-03634.

Descriptors: *Limnology, *Littlefield Lake, *Marl, *Carbonates, *Calcite, Sediments, Cores, Lake basins, Lakes, Macrophytes, Vegetation, Michigan.

Littlefield Lake is in a late stage of marl lake evolution characterized by reduced rates of carbonate precipitation. Long and short term carbonate budgets show that the volume of calcite in the lake basin is 3-7 times that expected from annual calcium depletion in the epilimnetic water. This Holocene decrease in carbonate production is also recorded as a gradual increase in the amount of organic and carbonate material in cores from the deep lake basin. Late-stage reduction in carbonate production is evidently a natural consequence of lakeward progradation of littoral marl benches, encroachment of terrestrial vegetation, and reduced colonization by carbonate-producing lake macrophytes. (Author's abstract)
W87-06679

PHOSPHORUS TRANSFER FROM SEDIMENTS BY MYRIOPHYLLUM SPICATUM,
Wisconsin Univ.-Madison. Dept. of Botany.
C. S. Smith, and M. S. Adams.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1312-1321, November 1986. 6 fig, 37 ref. NSF Grant DEB 75-19777.

Descriptors: *Limnology, *Bioaccumulation, *Phosphorus, *Cycling nutrients, *Watermilfoil, *Lake Wingra, *Sediments, Roots, Shoots, Aquatic plants, Phytoplankton, Lakes, Nutrients.

The uptake of phosphorus, the biomass, and the standing P stock were measured over the course of a year in roots and shoots of the Eurasian watermilfoil, Myriophyllum spicatum, from Lake Wingra, Wisconsin. The resulting data were used to estimate the relative contributions of root and shoot uptake to the phosphorus economy of the plant and to examine the role of the plant in moving phosphorus between sediment and water. The total yearly uptake of P by a square meter of Myriophyllum was 3.0 g P/sq m. Root uptake accounted for 2.2 g, shoot uptake only 0.8 g. The rate of P release from healthy shoots was insignificant, but about 2.8 g P/sq m/y was lost due to shoot turnover. Since most of the P uptake is by the roots and much of the plant P is transferred to and lost by the shoots, Myriophyllum is a potentially important vector in the movement of P from the sediments to the water. The net transfer of P from the sediments to shoots of Myriophyllum in Lake Wingra is about 2.0 g P/sq m/y. Release of this P during decay makes Myriophyllum an important source of P for pelagic phytoplankton and can explain much of the previously reported P export from the littoral zone of Lake Wingra. (Author's abstract)
W87-06680

COMPARISON OF METHODS FOR MEASURING PRODUCTION BY THE SUBMERSED MACROPHYTE, POTAMOGETON PERFOLIATUS L.,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
W. M. Kemp, M. R. Lewis, and T. W. Jones.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1322-1334, November 1986. 4 fig, 2 tab, 65 ref. EPA Grants R805932010 and X003248010.

Descriptors: *Isotope studies, *Primary productivity, Comparison studies, *Macrophytes, *Submerged plants, Aquatic plants, Oxygen, Chesapeake Bay, Biomass, Carbon.

Six conventional methods for measuring primary production of submerged vascular plants were compared to test for previously suggested inherent shortcomings in the O2-exchange techniques. Production was measured for experimental populations of Potamogeton perfoliatus L., from upper Chesapeake Bay in five comparative studies, each including an O2-exchange method. All techniques tested (14C incorporation and O2 evolution for both bottle incubations and undisturbed populations; biomass accumulation and inorganic carbon consumption for intact populations) compared favorably, with mean (molar) ratios of oxygen to carbon production ranging from 0.9 to 1.6. In addition, direct measurements indicated that rhizoshere release of O2 would introduce only small errors (<5%) in O2 production estimates. Although changes in lacunal storage of O2 can result in brief (5-25 min) delays between O2 production and evolution to the external water, simple methodological precautions can overcome such problems. We conclude that all available methods for measuring productivity of this and related species are potentially useful, each having its particular strengths and weaknesses, and the use of more than one method is recommended. (Author's abstract)
W87-06681

BACTERIAL GROWTH ON MACROPHYTE LEACHATE AND FATE OF BACTERIAL PRODUCTION,
Georgia Univ., Athens. Inst. of Ecology.
S. Findlay, L. Carlough, M. T. Crocker, H. K. Gill, and J. L. Meyer.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1335-1341, November 1986. 5 fig, 1 tab, 29 ref. NSF Grant DEB 83-06440.

Descriptors: *Productivity, *Biomass, *Bacterial growth, *Organic carbon, *Grazing, Macrophytes, Eutrophication, Flagellates, Estimating.

The role bacteria play in transferring organic carbon to other trophic levels in aquatic ecosystems depends on the efficiency with which they convert dissolved organic carbon into bacterial biomass and on the ability of consumers to graze bacteria. The conversion efficiency for bacteria growing on macrophyte-derived dissolved organic carbon was measured and estimated the amount of bacterial production removed by grazing was estimated. Bacteria converted this DOC into new tissue with an efficiency of 53%, substantially higher than the apparent conversion efficiency of macrophyte-derived particulate organic carbon or other types of DOC. Two estimates of grazing indicate that the decline in bacterial numbers after the bloom is probably due to grazing by flagellates. These results show the significance of the bacterial link between DOC and other trophic levels. (Author's abstract)
W87-06682

NUTRIENT LOADS TO WISCONSIN LAKES: PART I. NITROGEN AND PHOSPHORUS EXPORT COEFFICIENTS,
Rensselaer Polytechnic Inst., Troy, NY.
N. L. Clesceri, S. J. Curran, and R. I. Sedlak.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 983-990, December 1986. 1 fig, 7 tab, 38 ref.

Descriptors: *Nutrients, *Nitrogen, *Phosphorus, *Wisconsin, *Lakes, *Eutrophication, *Limnology, Land use, Watersheds, Forests, Agriculture, Basins, Regional analysis, Transport, Data collections, Estimating.

Export coefficients (kg/sq km/yr) for dissolved orthophosphate (OP), total phosphorus (TP), total inorganic nitrogen (TIN), and total nitrogen (TN) were derived for watersheds in Wisconsin using data bases available for 17 basins from the U.S. Environmental Protection Agency - National Eutrophication Survey, U.S. Geological Survey, and the Wisconsin Department of Natural Resources. Three general land use categories, representative of most regions in Wisconsin, were established: forest, mixed, and agricultural. Data for the 17 basins indicated greater exports of OP, TP, TIN, and TN as the percentage of forest decreased and agriculture increased. These region-specific coefficients are compared to the values reported in the literature representing much broader areas of the U.S. (See also W87-06691) (Author's abstract)
W87-06690

NUTRIENT LOADS TO WISCONSIN LAKES: PART II. RELATIVE IMPORTANCE OF NUTRIENT SOURCES,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 5B.
W87-06691

EXCHANGE RATES OF O2 AND CO2 BETWEEN AN ALGAL CULTURE AND ATMOSPHERE,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
H. Guterman, and S. Ben-Yaakov.
Water Research WATRAG, Vol. 21, No. 1, p 25-34, January 1987. 9 fig, 2 tab, 24 ref.

Descriptors: *Model studies, *Mathematical models, *Gas exchange, *Oxygen, *Carbon dioxide, *Algal cultures, *Atmosphere, Computers, Turbidity, Light intensity, Temperature, Monitoring, Photosynthesis, Simulation, Ponds, Algal growth, Carbon, Spirulina.

The mechanism of CO2 and O2 exchange between atmosphere and an algal mini-pond was examined by monitoring, with a novel microcomputer based system, pH, dissolved oxygen, turbidity, light intensity and temperature. The microcomputer based system was also used to monitor on-line the net oxygen production rate (OPR) and the gas ex-

change processes. The measured data support the assumption that the gas exchange is driven by the gradient of the partial pressure of the gases across the imaginary boundary layer (z layer). An analytical model based on this assumption was simulated by a computer and compared with the experimental data. The photosynthetic activity of a blue-green alga (Spirulina platensis) mini-pond as it is influenced by the CO2 concentration in the growth medium is discussed. The overall photosynthetic process was studied by comparing the experimental data with a mathematical model, evaluating the effectiveness of alternative carbon sources. (Author's abstract)
W87-06751

RELATIONSHIPS BETWEEN ULTRAVIOLET ABSORBANCE AND TOTAL ORGANIC CARBON IN TWO UPLAND CATCHMENTS,
Aberdeen Univ. (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 2E.
W87-06754

TRACE METALS AND WATER CHEMISTRY OF FOREST LAKES IN NORTHERN SWEDEN,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 5B.
W87-06756

IMPACT OF PADDLEFISH ON PLANKTON AND WATER QUALITY OF CATFISH PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 8I.
W87-06780

SURVIVAL OF EDWARDSIELLA ICTALURI IN POND WATER AND BOTTOM MUD,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
J. A. Plumb, and E. E. Quinlan.
The Progressive Fish-Culturist PFCUAY, Vol. 48, No. 3, p 212-214, July 1986. 1 fig, 9 ref. Regional cooperative research project S-168.

Descriptors: *Ponds, *Bottom sediments, *Mud, *Catfish, *Fish diseases, *Temperature effects, Infection, Fish, Sediments, Animal diseases, Temperature, Seasonal variation.

Edwardsiella ictaluri, the causative agent of enteric septicemia of catfish, is involved in about one-third of all disease cases in diagnostic laboratories where channel catfish (Ictalurus punctatus) is the predominant species examined. Edwardsiella ictaluri causes disease primarily when water temperatures range from 18 C to 28 C; these temperatures prevail during May and June and again in September and October in southern USA where catfish are cultured. Earlier reports that E. ictaluri does not survive in water were confirmed, but it was determined that it could survive in bottom muds of ponds. Survival of E. ictaluri was determined in pond water at 5 C and 25 C, and in bottom mud at 5 C, 18 C and 25 C. In mud incubated at 25 C, E. ictaluri maintained itself at densities of 10 to the 6.5 power cells/ml for 95 days; at 18 C the organism maintained approximately 10-fold higher densities for 40 days. However, E. ictaluri survived for less than 10 days in water 25 C and for less than 15 days in water and mud at 5 C. These data demonstrate that E. ictaluri can survive in pond bottom muds for an extended period of time; from this refuge, it may be a source of infection from spring through the fall. In view of these data, it is unlikely that E. ictaluri is a true obligate pathogen, but its survival is restricted by environmental conditions. (Author's abstract)
W87-06781

VERTICAL DIFFUSION IN A STRATIFIED COOLING LAKE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06833

ECOLOGICAL ASSESSMENT OF MACROPHYTON: COLLECTION, USE, AND MEANING OF DATA.
American Society for Testing and Materials, Philadelphia, PA.
A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. 122 p. Edited by W. M. Dennis and B. G. Isom.

Descriptors: *Limnology, *Ecological distribution, *Macrophytes, *Sampling, *Symposium, *Aquatic plants, Data collections, Data interpretation, Taxonomy, Plant populations, Aquatic systems, Ecosystems, Reviews.

Sampling of populations of aquatic macrophytes is discussed. Aquatic macrophytes (aquatic macrophyton) are an artificial grouping of taxonomically unrelated plants, sufficient in size to be seen with the unaided eye, which grow and reproduce primarily in aquatic habitats. It is a term of convenience and utility that includes the few aquatic lichens, macroscopic algae, bryophytes, ferns, fern allies, and angiosperms. This taxonomically diverse assemblage of plants also varies greatly in size and growth form. This diversity of size, form, and taxonomic affinity leads to problems in sampling design, accuracy, and precision. These problems are identified and explored, along with some proposed solutions. The symposium that produced the papers presented was an attempt to establish a baseline. In recent years much attention has been focused on aquatic macrophytes, both the beneficial functions they provide to aquatic systems and the problems they are more often causing in natural and artificial waterways. The need for methods that accurately and precisely describe and measure populations of aquatic macrophytes has become acute. Review of published literature reveals a lack of uniformity in methods. This lack of uniformity has led to results that are often not comparable, repeatable, or statistically valid. The symposium and these resulting papers an attempt to gather workers experienced in dealing with these problems to establish a baseline or compilation of currently used methods with the hope of moving forward to modify, improve, and standardize methods for sampling aquatic macrophyte populations. (See also W87-06900 thru W87-06911) (Lantz-PTT)
W87-06899

AQUATIC MACROPHYTON SAMPLING: AN OVERVIEW,
Breedlove Associates, Inc., Orlando, FL.
W. M. Dennis.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 2-6, 15 ref.

Descriptors: *Aquatic plants, *Macrophytes, *Sampling, *Limnology, Data acquisition, Remote sensing, Biomass, Ecosystems, Weeds.

Aquatic macrophytes constitute an integral part of aquatic ecosystems, contributing to primary productivity, providing habitat for various organisms, and modulating water quality. Recent attention on the characterization and understanding of aquatic macrophyte communities within North America has primarily been the result of water use problems caused by excessive infestations of 'weedy' aquatic plant species. Aquatic macrophyte communities have been sampled using such devices as oyster tongs and rakes, drag chains, various fixed size quadrates, and complex hydraulically controlled pontoon-mounted mechanical biomass samplers. More recently, subsurface sampling techniques have evolved using scuba, and remote sensing techniques have been developed using various platforms from balloons to fixed-wing aircraft to satellites. Sampling protocol for aquatic macrophyte studies should be designed to answer the specific question(s) at issue, applicable to the physical characteristics of the system, and able to provide reproducible results that allow comparison with other studies. The level of sampling detail is dictated by the complexity of the questions under consideration. Typical questions include what species are present, where, and in what amount. More complex questions may involve the functioning of aquatic macrophytes in nutrient and heavy metal uptake and turnover, their utilization as indicator organisms, and their effects on ambient water quality conditions. (See also W87-06899) (Author's abstract)
W87-06900

QUANTITATIVE METHODS FOR ASSESSING MACROPHYTE VEGETATION,
Wisconsin Geological and Natural History Survey, Madison.
S. A. Nichols.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 7-15, 3 tab, 12 ref.

Descriptors: *Experiment design, *Limnology, *Aquatic plants, *Macrophytes, *Sampling, Samplers, Quantitative analysis, Random sampling, Data acquisition.

Terms commonly used by terrestrial plant ecologists and applicable to the aquatic situation are defined. These terms include: quantitative and vegetation; the vegetation descriptors - frequency, density, and dominance; regular and random sampling patterns; and areal and arealess survey methods. Sampling strategies for planning an efficient sampling program are also discussed. Standard techniques and statistically sound procedures, along with common terminology and good sense, are needed to produce descriptions of macrophyton that have lasting value. To develop a common language for quantitatively describing macrophyton, the basic sampling techniques and vegetation descriptors, developed by terrestrial plant ecologists, need to be communicated to the larger audience of water resource managers. One of the problems with quantitative sampling of macrophyton is the great variability in the data. Specifically, the virtues of using an optimally allocated, stratified random sampling scheme and a large number of small quadrants as methods of increasing sample homogeneity and reducing the confidence interval that is placed on population estimates is pointed out. Reference is also made to techniques that can lower sample costs or consider sampling cost into calculations of acceptable sampling error. Finally, an efficient sampling program is well planned, and it must be a program based on statistics and good sense. Often preliminary surveys, such as the one done on Lilly Lake, WI, are time, effort, and money well spent when planning a sampling program. This is especially true if the information needs dictate that the area is to be sampled on numerous occasions. (Lantz-PTT)
W87-06901

AQUATIC MACROPHYTON FIELD COLLECTION METHODS AND LABORATORY ANALYSES,
Environmental Protection Agency, Athens, GA.
R. L. Raschke, and P. C. Rusanowski.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 16-27, 3 fig, 43 ref.

Descriptors: *Aquatic plants, *Macrophytes, *Sampling, *Sample preparation, *Limnology, Laboratory equipment, Plant morphology.

Field sampling methodology ranging from regional surveys to meristic measurements are presented for use by applied biologists faced with problems of measuring macrophyte response to environmental changes. A discussion of sampling gear recommended for use with the quadrat method is included. Treatment of plants for the purpose of identification and weight analysis is addressed, especially the problem of treating carbonate encrustations. Macrophytes are usually processed either while wet or after drying. Samples collected in the field can be identified, separated immediately, placed in plastic bags, and refrigerated or pressed and dried

with a plant press for identificationand processing. Dry weight is determined by drying representative samples for 24hr or to a constant weight at 105 C. After samples have dried for a specified time period, they should cool for 1 hr in a desiccator before dry weights are determined. To ascertain the organic content (ash-free organic weight) of a sample or subsample, incinerate it in a muffle furnace of 550 C for 1 to 6 hr, depending on the amount of material to be ashed; cool the ashed sample in a desiccator; rewet it; and dry it for 24 hr at 105 C. Remove the ashed sample from the oven, place it in a desiccator, and allow it to cool for 1 hr; then weigh it to obtain ash content. (See also W87-06899) (Lantz-PTT)
W87-06902

BIOSTATISTICAL ASPECTS OF MACROPHYTON SAMPLING,
Weston (Roy F.), Inc., West Chester, PA.
S. M. Gertz.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 28-35, 9 ref.

Descriptors: *Statistical analysis, *Macrophytes, *Aquatic plants, *Sampling, Graphical methods, Graphical analysis, Data evaluation, Limnology, Reviews, Experiment design.

Problems of sampling macrophytes are related to the types of communities under consideration and the goals of a particular study. The communities may range from completely submersed beds of large algae, mosses, pteridophytes, or angiosperms to rooted plants with floating leaves or floating plants with emergent leaves to wetland areas. The goals of a study may be community description or impact analysis. Because of this community and goal diversity a quantitative investigation often requires a rigorous statistical design to determine the best sampling design. Of the various sampling designs available there are two general techniques: plot or quadrat methods and plotless methods. Plot or quadrat methods are area methods of sampling communities where the plot may be rectangular, square, or circular, and all individuals in the plot are sampled. Plotless methods usually involve a more random approach of sampling; for example, a compass line is laid out through the community and samples are taken according to some fixed rule. Another type of common sampling, which may be plot or plotless, involves the use of transects. A transect is, in effect, a very long narrow rectangular plot, which may be divided into blocks with samples being selected by some fixed rule. Each of these sampling methodologies is best suited to a particular type of community and study. It is the purpose of this paper to review these various sampling methodologies and to evaluate their efficacy, in a statistical sense, in view of the goals of a specific study. (See also W87-06899) (Author's abstract)
W87-06903

FIRST-ORDER ERROR ANALYSIS FOR AQUATIC PLANT PRODUCTION ESTIMATES,
Notre Dame Univ., IN. Dept. of Biology.
S. R. Carpenter.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 36-45, 1 fig, 2 tab, 18 ref.

Descriptors: *Error analysis, *Aquatic plants, *Plant productivity, *Limnology, Statistical methods, Analysis of variance, Demography, Graphical analysis, Mathematical methods, Experiment design, Biomass.

Variance estimates are rarely reported or rigorously determined for net primary production by higher aquatic plants, yet the variance must be known before production estimates can be compared conclusively. Aquatic plant biomass and production data generally fulfill different purposes in ecological studies. Since production estimates require greater sampling effort, more assumptions, and more complicated statistical analyses than biomass estimates, researchers should not attempt to measure production where biomass data will suffice. Biomass, as a measure of community structure, reflects habitat available for a diverse community of epiphytes and invertebrates, and a potential refuge from fish predation for many animals. Production reflects new organic matter that is available to consumers or detrital processing and nutrient recycling mechanisms. Photosynthesis rate, decay rate, and demographic approaches to macrophyte production studies have not been compared with respect to sampling effort required for an adequately precise production estimate. First-order error analysis is used here to derive formulae for estimating the variance of annual net production determined by demographic methods. Demographic methods determine net production of even-aged cohorts by analyzing curves of survivorship versus plant mass (Allen curves). Allen curves may be interpolated linearly or logarithmically. Calculation formulae for both alternatives are derived and compared in a common framework. Logarithmic interpolation is more consistent with observed thinning dynamics of even-aged plant stands. (See also W87-06899) (Lantz-PTT)
W87-06904

DEVELOPMENT AND USE OF THE WATERWAYS EXPERIMENT STATION'S HYDRAULICALLY OPERATED SUBMERSED AQUATIC PLANT SAMPLER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7B.
W87-06905

OSBORNE SUBMERSED AQUATIC PLANT SAMPLER FOR OBTAINING BIOMASS MEASUREMENTS,
University of Central Florida, Orlando. Dept. of Biological Sciences.
For primary bibliographic entry see Field 7B.
W87-06906

PROBLEMS IN THE USE OF CLOSED CHAMBERS FOR MEASURING PHOTOSYNTHESIS BY A LOTIC MACROPHYTE,
Texas Univ. at Dallas, Richardson. Center for Environmental Studies.
B. H. Hill, J. R. Webster, and A. E. Linkins.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 69-75, 4 fig, 30 ref.

Descriptors: *Isotope studies, *Growth chambers, *Macrophytes, *Photosynthesis, *Lotic environment, *Limnology, Measuring instruments, Podostemum ceratophyllum, Oxygen, Carbon radioisotopes, Carbon dioxide, Hydrogen ion concentration, Experiment design.

Photosynthesis by Podostemum ceratophyllum in closed production chambers became inhibited by oxygen accumulation and carbon depletion during field investigations. Carbon-14 uptake by this plant during 180-min experiments was initially rapid, then decreased abruptly. The photosynthetic response corresponded to increased oxygen concentration of the chamber water and increased excretion of labelled organic carbon from the plants. Photosynthesis was probably further inhibited by inorganic carbon depletion since this plant is unable to use HCO3(-) as a carbon source. Alkalinity and pH in the chambers decreased and increased, respectively, reflecting this depletion of available carbon dioxide. These data suggest that use of sealed chambers for aquatic macrophyte production studies may seriously underestimate actual production. (See also W87-06899) (Author's abstract)
W87-06907

RELATIONSHIPS BETWEEN AQUATIC MACROPHYTES AND THE CHEMICAL AND PHYSICAL COMPOSITION OF THE SUBSTRATE IN KAHLE LAKE, CLARION-VENANGO COUNTIES, PENNSYLVANIA,
K. A. McKenna.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 76-87, 2 fig, 5 tab, 36 ref.

Descriptors: *Aquatic plants, *Macrophyte, *Kahle Lake, *Pennsylvania, *Limnology, Lake chemistry, Lake morphology, Najas flexilis, Particle size, Organic matter, cations, Plant growth.

Excessive growth of Najas flexilis in Kahle Lake creates a threat to the naturalaging process of the eight year old impoundment. An over winter drawdown was performed in 1977, but was ineffective in controlling N. flexilis. The intent of this research was to investigate edaphic factors that may influence aquatic macrophyte establishment and abundance within the littoral zone of Kahle Lake. Sampling areas were selected such that three sites were established in locations of abundant plant cover and three sites in locations of minimal plant growth. The variables measured included substrate particle size fractions, percentage organic matter, exchangeable cations, and aquatic macrophyte standing crop. Knowledge of significant habitat characteristics is pertinent to the application of control techniques designed to minimize plant infestation. Plant and substrate samples were processed and data analyzed to determine variations between sampling sites. Nonparametric testing showed that mean percent gravel differed significantly between areas of abundant and minimal plant growth. Mean percent organic matter within the substrate did not differ among sites. Nonparametric testing showed that mean percent gravel differed significantly between areas of abundant and minimal plant growth. Meanpercent organic matter within the substrate did not differ among sites. Correlation analysis indicated that aquatic macrophyte standing crop and percent fine sand were significantly associated. (See also W87-06899) (Author's abstract)
W87-06908

MAPPING-SURFACE OR GROUND SURVEYS,
Environmental Protection Agency, Athens, GA. Environmental Services Div.
R. L. Raschke.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16. 1983. 1984. p 88-91, 1 fig, 2 ref.

Descriptors: *Mapping, *Aquatic plants, *Vegetation maps, Surveys, Field tests.

Preparation of vegetation maps from ground surveys as the first step in a field study is discussed. Depending upon the degree of accuracy required, various types of equipment are suggested for use in a mapping survey. Details are presented on station or point selections with a discussion of procedures and calculation of angles and distances using an illustrated example. Additional information is presented about kinds of information, explanatory material, and symbols used in constructing vegetation maps. (See also W87-06899) (Author's abstract)
W87-06909

USE OF AERIAL REMOTE SENSING IN QUANTIFYING SUBMERSED AQUATIC MACROPHYTES,
Tennessee Valley Authority, Chattanooga. Mapping Services Branch.
For primary bibliographic entry see Field 7B.
W87-06910

USE OF SMALL-FORMAT AERIAL PHOTOGRAPHY IN AQUATIC MACROPHYTON SAMPLING,
Breedlove Associates, Inc., Orlando, FL.
For primary bibliographic entry see Field 7B.
W87-06911

USE OF A THREE-PHASE MICROCOSM FOR ANALYSIS OF CONTAMINANT STRESS ON AQUATIC ECOSYSTEMS,
Tennessee Technological Univ., Cookeville.
For primary bibliographic entry see Field 5B.
W87-06915

REALISM AND REPLICABILITY OF LENTIC FRESHWATER MICROCOSMS,
California Univ., Berkeley. Lawrence Berkeley Lab.
D. Levy, G. Lockett, J. Oldfather, J. Rees, and E. Saegebarth.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 43-56, 3 fig, 9 tab, 9 ref, append.

Descriptors: *Limnology, *Microcosms, *Lentic environment, Aquatic environment, Ecosystems, Phytoplankton, Water agitation, Zooplankton, Simulation analysis, Taxonomy, Statistical analysis.

Microcosms designed to simulate the pelagic epilimnion of a lentic freshwater body were compared with the natural system from which they were derived. Emphasis was placed on determining the influence of water agitation on microcosm realism and replicability. In two experiments, excellent tracking of the natural system for 4 to 6 weeks and excellent replication among microcosms was observed; the dominant phytoplankton and zooplankton taxa in the microcosms were not statistically distinguishable from those measured in the natural systems. In a third experiment, the dominant taxa in the 50-L microcosms could be statistically distinguished from the variables in the natural system. In all three experiments, correlations between the taxonomic variables and the chemical variables, when present in the natural system, were observed in the microcosms. (See also W87-06912) (Author's abstract)
W87-06916

EXPERIMENTAL PONDS FOR EVALUATING BIOASSAY PREDICTIONS,
Kansas Univ., Lawrence. Experimental and Applied Ecology Program.
For primary bibliographic entry see Field 5C.
W87-06919

CALIBRATION OF LABORATORY BIOASSAYS WITH RESULTS FROM MICROCOSMS AND PONDS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-06920

ACIDIFICATION OF SURFACE WATERS IN EASTERN CANADA AND ITS RELATIONSHIP TO AQUATIC BIOTA,
Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Fisheries Research Branch.
J. R. M. Kelso, C. K. Minns, J. E. Gray, and M. L. Jones.
Department of Fisheries and Oceans, Ottawa, Ontario. Canadian Special Publication of Fisheries and Aquatic Sciences 87, 1986. 42 p, 11 fig, 34 tab, 103 ref, 2 append.

Descriptors: *Acidic water, *Lakes, *Rivers, *Canada, *Water pollution effects, *Limnology, *Acid rain, Hydrogen ion concentration, Fish, Zooplankton, Phytoplankton, Mercury, Aluminum, Manganese, Iron, Heavy metals, Species composition.

Data collected by the Department of Fisheries and Oceans in lakes and rivers of eastern Canada subjected to atmospheric deposition, essentially > 20 kg SO4(2-)/ha/yr, indicated that the trend of fewer species of fish, phytoplankton, zooplankton, and benthos below pH 6 persists. Not only are there fewer species below pH 6, but also the abundance of at least fish (as reflected by catch per unit effort) declines with decreasing pH. It is also evident that physical limits of the aquatic habitat exerts a strong influence upon diversity at all community levels. This intrinsic effect from the habitat is then further influenced by pH and alkalinity. Fish body burdens of trace metals (Hg, Al, Mn, Fe) appear weakly related to lake pH/alkalinity conditions. All provinces had fish from remote lakes with body burdens of Hg in excess of human health guidelines. In all provinces except New Brunswick, 27-47% of lakes had fish exceeding these public health guidelines. All indicators of lake sensitivity (> 1,200 sq km of lake surface area already acidic; alkalinity < 0 microequivalents/L, approximately pH 5.3 and less). Overall, it is estimated that there are 700,000 lakes in eastern Canada receiving deposition considerably above background; that 4,243 sq km (>14,000 lakes) are currently acidic; and that more than 150,000 lakes have a pH < 6.0, a level identified as a threshold of effect. (Author's abstract)
W87-06997

CE-QUAL-W2: A NUMERICAL TWO-DIMENSIONAL, LATERALLY AVERAGED MODEL OF HYDRODYNAMICS AND WATER QUALITY; USER'S MANUAL.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA 22161. Instruction Report E-86-5, August 1986. Final Report. 318 p, 22 fig, 25 tab, 206 ref, 3 append.

Descriptors: *Hydrodynamics, *Model studies, *Water quality, *CE-QUAL-W2, Mathematical models, Computer programs, Lakes, Reservoirs, Mathematical equations.

This manual describes the two-dimensional, laterally averaged hydrodynamic and water quality model CE-QUAL-W2 developed by the Environmental and Hydraulics Laboratories, US Army Engineer Waterways Experiment Station, and provides guidance in its use. The model was developed primarily for use in reservoirs but has applicability to lakes, rivers, and estuaries. The manual is organized into four major parts with several appendices. In Part I, CE-QUAL-W2 is introduced to the reader by summarizing its major usages, attributes, and historical development. Part II addresses model capabilities, assumptions, and limitations and supplies the basic information required to use the model. Part II outlines in detail the structure of CE-QUAL-W2, including the basic model equations and solution procedures. Part IV provides additional details of data assembly, presents literature values of various coefficients and constants, and discusses how to calibrate the model and interpret output. (Author's abstract)
W87-07004

EXPERIMENTAL MANIPULATIONS OF PHYTOPLANKTON IN EAU GALLE RESERVOIR,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Barko, A. R. Klemer, D. G. McFarland, and M. S. Hennington.
Available from the National Technical Information Service, Springfield, VA 22161. Miscellaneous Paper E-86-4, August 1986. Final Report. 18 p, 5 fig, 3 tab, 23 ref.

Descriptors: *Phytoplankton, *Eau Galle Reservoir, *Water quality control, *Limnology, *Eutrophication, *Wisconsin, *Algae, Water columns, Phosphorus, Nutrients, Sedimentation, Chemical precipitation, Mixing, Destratification.

Poor water quality in Eau Galle reservoir, located in west-central Wisconsin, has been associated historically with an overabundance of nuisance planktonic algae (phytoplankton) during the summer months. In an attempt to improve water quality, a variety of experiments was conducted over a 2-year period in large (10-m-diameter) enclosed water columns. Specific objectives of these experiments were to reduce phytoplankton standing crop and to promote favorable changes in species composition, i.e., away from nuisance algae (cyanophytes and dinoflagellates) toward more desirable algae (diatoms and chlorophytes). Experimental treatments, implemented singly and in combination, included destratification by mixing, addition of soluble silica, sediment sealing with sand, and precipitation of phosphorus with block aluminum sulfate. Mixing, alone or in combination with silica addition, extended the presence of vernal diatom populations into the summer in one investigation. In contrast, addition of silica to the water column without mixing had no effect on diatom production. In general, mixing stimulated phytoplankton production by increasing phosphorus availability. However, phosphorus inactivation with block aluminum sulfate suspended in the water was sufficient to overcome this effect. Individual effects of phosphorus precipitation and sediment sealing were similar; both decreased phytoplankton standing crop in association with decreased total phosphorus concentrations. Since most of the phosphorus contributed to the phytoplankton in Eau Galle reservoir derives from the sediment, complexation of sediment phosphorus is recommended to improve water quality. (Author's abstract)
W87-07005

HANDBOOK ON RESERVOIR RELEASES FOR FISHERIES AND ENVIRONMENTAL QUALITY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W87-07008

WETLANDS INVESTIGATIONS ON AKERS RANCH IN BIG VALLEY, CALIFORNIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2C.
W87-07034

HYPOLIMNETIC AERATION: FIELD TEST OF THE EMPIRICAL SIZING METHOD,
Ministry of Environment, Vancouver (British Columbia). Fisheries Research and Technical Services Section.
For primary bibliographic entry see Field 5G.
W87-07059

GENERALIZED STORAGE-RELIABILITY-YIELD RELATIONSHIPS,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
R. M. Vogel, and J. R. Stedinger.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 303-327, January 1987. 2 fig, 6 tab, 44 ref.

Descriptors: *Water yield, *Reservoir storage, *Model studies, *Reservoir capacity, *Streamflow, *Algorithms, Design criteria, Reservoirs, Storage, Estimating.

Traditionally water resource engineers have employed Rippl's mass curve approach or its automated equivalent sequent peak alogrithm, in conjunction with the historical streamflow sequence to obtain a single estimate of the design capacity of a storage reservoir. More recently stochastic streamflow models have been recommended for use in deriving the probability distribution of the required capacity of a storage reservoir to maintain a prespecified release. The use of stochastic streamflow models in conjunction with the sequent peak algorithm leads to a storage-reliability-yield (S-R-Y) relationship. This study develops approximate but general expressions which describe the over-year S-R-Y relationship when annual streamflows are log normal and follow a first-order autoregressive model. These expressions were developed for three reasons: (1) to provide preliminary design capacity or yield estimates for storage reservoirs governed by over-year storage requirements; (2) to improve our understanding of the S-R-Y relationship; and (3) to facilitate Monte-Carlo experiments which examine the sampling properties of reservoir design capacity and/or yield estimates. (Author's abstract)

W87-07068

ESTIMATION OF BACTERIAL NITRATE REDUCTION RATES AT IN SITU CONCENTRATIONS IN FRESHWATER SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 5A.
W87-07075

BACTERIAL COMMUNITIES IN ACIDIC AND CIRCUMNEUTRAL STREAMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-07078

FLOWTHROUGH REACTOR FLASKS FOR STUDY OF MICROBIAL METABOLISM IN SEDIMENTS,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
R. L. Smith, and M. J. Klug.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 2, p 371-374, February 1987. 4 fig, 22 ref. NSF Grants DEB 78-05321 and DEB 81-09994.

Descriptors: *Microbial metabolism, *Anoxic sediments, *Flowthrough reactor flasks, *Nutrients, *Sulfates, *Eutrophic lakes, Simulation, Acclimatization, Incubation, Inhibition, Xenobiotic compounds.

Flowthrough reactor flasks are described that allow continuous low-level nutrient input to mixed anoxic sediments without dilution of the sediment. The flasks were tested by simulating sulfate inputs into sediments collected from a freshwater eutrophic lake. After an initial 2-day adaptation within the reactor system, rates of methane production and sulfate consumption were constant for the duration of a 12-day incubation. A sulfate input rate of 0.15 mmol/liter of sediment/day resulted in an equivalent rate of sulfate removal, which was unaffected by inputs of acetate (1.0 mmol/liter of sediment/day). The rate of methane production in control reactors, 0.18 mmol/liter of sediment/day, was doubled by the addition of acetate, whereas sulfate consumption was only stimulated by additions of high concentrations of sulfate plus acetate (1.5 and 1.0 mmol/liter of sediment/day, respectively). The reactor system appears to be effective in maintaining the balance between sulfate reduction and methane production in freshwater sediments and is potentially useful for study of the response of sediment populations to varying inputs of naturally occurring substrates, selected inhibitors, or xenobiotic compounds. (Author's abstract)
W87-07079

STATUS AND TRENDS OF FRESHWATER WETLANDS IN THE COAL-MINING REGION OF PENNSYLVANIA, USA,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 4C.
W87-07083

EXTERNAL THREATS AND INTERNAL MANAGEMENT: THE HYDROLOGIC REGULATION OF THE EVERGLADES, FLORIDA, USA,
East Texas State Univ., Commerce. Dept. of Biological Sciences.
J. A. Kushlan.
Environmental Management EMNGDC, Vol. 11, No. 1, p 109-119, January 1987. 8 fig, 19 ref.

Descriptors: *Marshes, *Environmental effects, *Water resources management, *Everglades National Park, Reproduction, Population dynamics, Model studies, Decision making, Policies, Florida.

The ecological character of seasonal marshes is determined in large part by the pattern of water level fluctuation. As a result, the ecological health of a wetland reserve can be controlled by hydrologic regulation external to its boundaries. As an example, the Everglades marsh of Everglades National Park in Florida, USA, has been severely effected by management of the inflow of surface water. The Everglades occupies most of the interior of southern Florida, but only the lower 6% of the original marsh is contained in Everglades National Park. Shallow surface water reservoirs north of the park enclose 3600 km2 of Everglades. Their levee system confines surface water flow into the park to several structures. Historically this water flowed across the entire core of the natural drainage. Flows into the park have been on a congressionally mandated schedule of minimum deliveries that is supplemented by additional water released into the park in amounts determined solely by upstream water management needs. Research, aimed at evaluating the effects of water conditions, has shown that this regulatory system has adversely affected reproductive success, community structure, and population sizes of sensitive species whose population stability is tied to natural water level fluctuations. These adverse effects were caused by water levels that for over a decade have been maintained at unseasonably high levels. Mathematically deterministic models of water level effects can provide management options based on biological criteria. Park managers must incorporate understanding gained from such models into internal management decisions. Modifications of water control structures and alternative policies for managing the distribution and amount of surface water flow into the park appear attainable, can improve biological conditions in the park, and need not be adverse to neighboring external interests. Thus far biological changes are severe, and to a large extent irreversible. Ecologically sensitive management of an external threat under constraints imposed by history and setting can better maintain some semblance of ecological processes in the Everglades. If management decisions do not reflect such understanding of ecological processes, further ecological deterioration will result. (Author's abstract)
W87-07087

COLLECTIONS OF THREATENED, ENDANGERED, AND UNIQUE FISH SPECIES IN KANSAS STREAMS: YEAR 1982,
Kansas Fish and Game Commission, Pratt. Environmental Services Section.
W. G. Layher, and R. D. Wood.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 1-8, 1986. 2 ref.

Descriptors: *Streams, *Kansas, *Endangered species, *Species composition, *Taxonomy, Fish habitats, Protection.

Collections of threatened, endangered and unique species are discussed along with general habitat characteristics at collection sites. Documentation of locations of collections of threatened and endangered species is necessary to properly administer laws and regulations governing protection of those species and their habitats. (Author's abstract)
W87-07088

COMPARISON OF THE GROWTH OF DAPHNIA FED CONTINUOUSLY AND AT REGULAR INTERVALS,
Kansas State Univ., Manhattan. Div. of Biology.
J. A. Arruda.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 90-96, 1986. 1 fig, 2 tab, 10 ref. NSF Grant DEB-8207214.

Descriptors: *Daphnia, *Food habits, *Growth, *Diets, Sedimentation, Grazing, Toxicity, Nutrition.

The effects of food quality, competition, or potentially toxic substances on the growth and survival of Daphnia can be determined by renewing food daily in a small container or by continuously providing food with a flow through system. Sedimentation and grazing in containers will lower food concentration to below the experimental level. Daphnia pulex fed at low food concentrations in a simple continuous flow system grew more than those fed in small containers. The growth of Daphnia pulex will be underestimated if the feeding suspension is supplied in daily renewals. (Author's abstract)
W87-07089

SUMMARY OF REPORTED FISH KILLS IN KANSAS DURING 1983,
Kansas Fish and Game Commission, Pratt. Fisheries Div.
K. L. Brunson.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 134-145, 1986. 6 fig, 2 tab, 7 ref.

Descriptors: *Fishkills, *Kansas, *Water pollution effects, *Economic aspects, Ponds, Streams, Fish, Mortality, Water deficit, Agriculture.

Sixty-five fish kill incidents were reported to the Kansas Fish and Game Commission during 1983. These involved nearly a quarter million individual fish mortalities representing a monetary worth of about $160,000. The mean number of mortalities per incident was 1608 with an associated mean loss value of $1,150. Pond kills comprised the most frequent water body class investigated with 35 reports being received. Streams suffered the most significant fish mortalities with two reaches in western Kansas sustaining estimated losses of nearly 370,000 fish because of water depletion. This constituted over 80 percent of all fish mortalities from all reported fish kills in 1983. Natural phenomena exceeded all other sources in causing fish kills. Problems stemming from agricultural origins contributed to a large majority of total fish mortalities. (Author's abstract)
W87-07091

NEW DISTRIBUTIONAL RECORDS FOR SOME KANSAS FISHES,
Kansas Fish and Game Commission, Pratt.
W. G. Layher, and K. L. Brunson.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 124-133, 1986. 1 tab, 22 ref.

Descriptors: *Taxonomy, *Species composition, *Surveys, *Fish species, *Kansas, *Streams, Fish populations.

The physical, chemical, and biological natures of streams are constantly changing. Along with these transformations, fish communities shift over time, favoring species more adaptable to new environments. Probably more important than short-term disruptions of native stream fish populations are major ecosystem alterations, for example, extensive channel and flow modifications, or long-term subtle disturbances such as water quality degradations due to nutrient loading and suspended solid concentrations. From a biological and historical viewpoint, it is important to document changes in the fish fauna of streams that may be because of these disturbances. This article presents new fish species distributional accounts as a result of completion of a long-term survey of most of the streams in Kansas by the Kansas Fish and Game Commission. (Author's abstract)
W87-07092

AQUATIC MACROINVERTEBRATES AND FISHES OF BIG CREEK IN TREGO, ELLIS, AND RUSSEL COUNTIES, KANSAS,
Fort Hays State Univ., Hays, KS. Dept. of Biological Sciences.
M. Eberle, G. Ernsting, and J. Tomelleri.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 146-151, 1986. 2 tab, 31 ref.

Descriptors: *Macroinvertebrates, *Big Creek, *Surveys, *Taxonomy, *Fish, *Species composition, *Kansas, Invertebrates, Fish populations.

Seven taxa of aquatic invertebrates and 27 species of fish are reported from a biological survey of Big Creek in Trego, Ellis, and Russell counties, Kansas conducted during 1983 and 1984. The present fauna is compared to previous faunal surveys. (Author's abstract)
W87-07093

DIATOMS FROM STREAMS IN ELLIS AND RUSSELL COUNTIES, KANSAS,

Fort Hays State Univ., Hays, KS. Dept. of Biological Sciences.
T. L. Wenke, and M. E. Eberle.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 162-168, 1986. 1 tab, 12 ref. NSF Grant R11-8213915.

Descriptors: *Diatoms, *Surveys, *Streams, *Kansas, *Taxonomy, Algae, Big Creek, Saline River, Smoky Hill River, Salt Creek.

A survey of diatoms from west-central Kansas was initiated in 1979 with collections made at several localities on an irregular basis. A list of taxa from benthic samples collected in Big Creek, Saline River, Salt Creek, and Smoky Hill River in Ellis and Russell counties was compiled. The only known report published previously that includes diatoms from streams in this study area is that of Czarnecki and Reinde (1981) who identified nine taxa from Salt Creek. McFarland (1959) included six taxa of diatoms in his thesis on the algae of Trego and Ellis counties, and some of the samples collected at that time were examined during this study. In the study area, Big Creek, Saline River, and Smoky Hill River are similar physically and chemically. The pH is between 7.0 and 8.5, and specific conductance is between 500 and 3000 micromhos per centimeter. Salt Creek has a similar pH, but is unique among the four streams surveyed because of its greater specific conductance which has been as high as 20,000 micromhos per centimeter on collections dates. (Author's abstract)
W87-07094

EVALUATION OF A 'RELIABILITY PROGRAMMING' RESERVOIR MODEL,
Institute of Atomic Energy, Otwock-Swierk (Poland).
J. B. Strycharczyk, and J. R. Stedinger.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 225-229, February 1987. 1 fig, 2 tab, 32 ref. NSF Grant CEE-8351819.

Descriptors: *Reservoirs, *Model studies, *Reservoir design, *Mathematical models, Evaluation, Reservoir operation, Reservoir capacity, Mathematical equations, Mathematical studies, Algorithms, Model testing.

A recent series of papers presented a 'reliability programming' formulation of reservoir design and operating problems. The algorithms employ a chance-constrained formulation of reservoir operating constraints and system objectives, but avoid use of linear decision rules. Examination of the reliability programming formulation of the reservoir management problem reveals that the reservoir model employs a very restrictive operating policy. In a numerical example the reliability programming model's constraints overestimated reservoir capacity requirements by an order of magnitude. The basic reliability programming formulation of reservoir management issues is also questioned. (Author's abstract)
W87-07103

IMPORTANCE OF SEDIMENT SULFATE REDUCTION TO THE SULFATE BUDGET OF AN IMPOUNDMENT RECEIVING ACID MINE DRAINAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-07109

AERATION-INDUCED CIRCULATION FROM LINE SOURCES. I: CHANNEL FLOWS,
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 5G.
W87-07123

AERATION-INDUCED CIRCULATION FROM LINE SOURCES. II: DISSOLVED OXYGEN VARIATIONS,
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 5G.
W87-07124

CALCIUM CARBONATE PRECIPITATION AND TRANSPARENCY IN LAKES: A CASE STUDY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5G.
W87-07125

BRINGING UP OYSTERS,
M. Leffler.
Oceans, Vol. 19, No. 6, p 38-43, December 1986.

Descriptors: *Oysters, *Aquaculture, *Legal aspects, *Water resources development, *Estuarine fisheries, *Commercial fishing, Chesapeake Bay, Leases, Estuaries, Aquatic life, Bays, Ownership of beds.

Methods are described which are being tested as ways to develop oyster production in the Chesapeake Bay region. Oyster harvesting from this region has fallen from a peak of 15 million bushels in 1894 to about 2 million bushels per year at present. Specific problems are preventing the full exploitation of leased land. Some of these are: expensive oyster seed, lack of sufficient shell as substrate, poaching, and an unpredictable climate. One means to cheaper seed that is being explored is 'remote setting', a technique that has been used on the West Coast. Production of a sufficient quantity of spat (young oysters) is still problematic, and there may eventually be support for many small hatcheries in order to fill this need. The history of oyster farming and its regulation during the nineteenth and twentieth centuries is outlined. (Airone-PTT)
W87-07134

UV-EXTINCTIONS OF AQUATIC HUMIC ACIDS: ITS DEPENDENCE ON THE ELEMENTAL COMPOSITION,
Gesamthochschule Essen (Germany, F.R.). Inst. fuer Physikalische und Theoretische Chemie.
For primary bibliographic entry see Field 2K.
W87-07144

TOXICITY OF SOME RICEFIELD PESTICIDES TO THE CRAYFISH P. CLARKII UNDER LABORATORY AND FIELD CONDITIONS IN LAKE ALBUFERA (SPAIN),
Valencia Univ. (Spain). Dept. of Animal Physiology.
For primary bibliographic entry see Field 5C.
W87-07146

CHEMICAL COMPOSITION OF THE PALMIET RIVER WATER,
Durban-Westville Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-07151

CONTROL OF XENOPUS LAEVIS (AMPHIBIA: PIPIDAE) IN FISH PONDS WITH OBSERVATIONS ON ITS THREAT TO FISH FRY AND FINGERLINGS,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W87-07156

DIET SPECTRA AND RESOURCE PARTITIONING IN THE LARVAE AND JUVENILES OF THREE SPECIES AND SIX COHORTS OF CYPRINIDS FROM A SUBALPINE LAKE,
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
W. Mark, R. Hofer, and W. Wieser.
Oecologia OECOBX, Vol. 71, No. 3, p 388-396, February 1987. 3 fig, 5 tab, 27 ref. Fonds zur Forderung der Wissenschaftlichen Forschung in Osterreich Project S-35/04.

Descriptors: *Diets, *Limnology, *Food habits, *Cyprinids, *Subalpine lakes, *Larvae, Austria, Phytoplankton, Rotifers, Crustaceans, Chironomids, Predation, Growth.

Diet composition based on gut analyses was studied in larvae and juveniles belonging to six (out of eight) age groups (cohorts) of three species of cyprinids (Rutilus rutilus L., Leuciscus cephalus L., Scardinius erythrophthalmus L.) from a small meso-oligotrophic lake in Tyrol, Austria. A basic pattern of ontogenetic shifts of resource use is postulated for the first weeks after hatching, consisting of the sequence: phytoplankton - rotifers - crustaceans - chironomid larvae. However, there are several variations to this general theme. Diet overlap is of about the same magnitude between representatives of different species or different cohorts, and between members of schools belonging to one cohort. This points to the importance of random food selection in all larvae and juveniles during this phase of life. Prey size is a very poor predictor of food choice by young cyprinids, but there is greater similarity in diet between the larger juveniles than between the smaller larvae, irrespective of whether the fish compared represent different species, different cohorts or are members of homogeneous groups. The lack of correlation between prey size and predator size may be explained by assuming that out of a limited range of available prey size the fish always 'try' to include in their diet also the largest items they are able to swallow. This would be a good strategy considering that growth rates are positively correlated with food size. One clearcut interspecific difference in resource use may be noted: The larvae of L. cephalus are distinguished from those of the other two species by the absence of rotifers and nauplii in their diet, and by their greater ability to handle both adult copepods and chironomid larvae. (Author's abstract)
W87-07173

FEEDING OF TROPICAL FRESHWATER FISHES: SEASONALITY IN RESOURCE AVAILABILITY AND RESOURCE USE,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Prejs, and K. Prejs.
Oecologia OECOBX, Vol. 71, No. 3, p 397-404, February 1987. 4 fig, 7 tab, 25 ref.

Descriptors: *Diets, *Food habits, *Seasonal variation, Invertebrates, Algae, Predation, Fish, Resource use.

Food resources in the environment and in the diets of small fish inhabiting two water bodies in a tropical savanna were studied during both wet and dry seasons. During the wet season (high water, abundant food) most fish species in both habitats fed predominantly on vegetation-dwelling invertebrates. Most fish species switched to alternative foods (algae and detritus) following the drastic decline in invertebrate food available towards the end of the dry season. In one habitat, this change in diet was accompanied by an increase in the volume of food intake. In the second habitat, only two larger species foraged intensively, while smaller species showed low food intake or almost ceased feeding. These differences may be explained by the high risk of predation for small fish in the second habitat. Dietary overlaps among fish species were high at the end of the dry season and moderate in the wet season. However, critical analysis of such factors as food abundance, the size and number of shared prey, and diet breadth showed that all significant overlaps were ecologically unimportant i.e. there was only weak competition for food. (Author's abstract)
W87-07174

COMPARISON OF STOCHASTIC AND DETERMINISTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPERATING RULE GENERATION,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6A.
W87-07175

PREDICTING BASEFLOW ALKALINITY AS AN INDEX TO EPISODIC STREAM ACIDIFICATION AND FISH PRESENCE,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 5B.
W87-07178

RELATIONSHIP OF WATER QUALITY AND FISH OCCURRENCE TO SOILS AND GEOLOGY IN AN AREA OF HIGH HYDROGEN AND SULFATE ION DEPOSITION,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 5C.
W87-07179

CALCIUM CARBONATE PRECIPITATION AND TURBIDITY MEASUREMENTS IN OTISCO LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and D. L. Johnson.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 73-79, February 1987. 5 fig, 1 tab, 19 ref.

Descriptors: *Chemical precipitation, *Calcium carbonate, *Whiting, *Turbidity, *Alkaline lakes, *Otisco Lake, Acidification, Water quality, Water treatment, Lakes, Reservoirs, New York.

Calcium carbonate precipitate, known as 'whiting,' forms in a large number of hard water lakes and reservoirs, and thus contributes to turbidity measurements in these systems. Here we document the occurrence of 'whitings,' and the associated impact on turbidity, in Otisco Lake, New York. A simple, potentially broadly applicable technique, measurement of turbidity before and after acidification, successfully quantified this component of turbidity in the lake. Calcium carbonate represented 32 percent of the turbidity in the upper waters of Otisco Lake for a three-month period, and at times was as much as 70 percent. Routine monitoring of this component of turbidity in raw water sources, where it is significant, should provide insight into water quality management and treatment plant operations. (Author's abstract)
W87-07182

GREAT LAKES POLICIES AND HYDROSPHERIC AND ATMOSPHERIC RESEARCH NEEDS,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 6B.
W87-07200

ARSENIC, ANTIMONY AND SELENIUM SPECIATION DURING A SPRING PHYTOPLANKTON BLOOM IN A CLOSED EXPERIMENTAL ECOSYSTEM,
Southampton Univ. (England). Dept. of Chemistry.
S. C. Apte, A. G. Howard, R. J. Morris, and M. J. McCartney.
Marine Chemistry MRCHBD, Vol. 20, No. 2, p 119-130, November 1986. 6 fig, 2 tab, 22 ref.

Descriptors: *Eutrophication, *Arsenic, *Antimony, *Selenium, *Diatoms, *Phytoplankton, *Limnology, Speciation, Blooms, Heavy metals, Ions, Nutrients, Biomethylation, Scotland.

A study was made of the effects of a spring diatom bloom on the levels and speciation of dissolved arsenic, antimony and selenium in the water enclosed in an experimental ecosystem moored in Loch Ewe (NW Scotland). Primary productivity resulted in severe depletion of phosphate and silicate in the bag, but had little effect on the levels and speciation of arsenic and antimony. Calculations based on phosphate depletion data strongly suggest that the field diatom population present during the experiment was capable of some degree of discrimination between phosphate and arsenate ions. Whilst biomethylation of arsenic was not observed in the upper region of the bag, where the phytoplankton population was at its greatest, the methylated form accounted for 64% of the dissolved arsenic at the base of the bag. In this region, however, the total dissolved arsenic levels were not higher than in the rest of the bag, suggesting microbial methylation of dissolved arsenic rather than the release of methylated arsenic from decaying phytoplankton. Total dissolved selenium and selenium(IV) showed some evidence of depletion during the development of the phytoplankton bloom, in support of previous observations of preferential selenite assimilation. (Author's abstract)
W87-07217

POPULATION DYNAMICS AND SECONDARY PRODUCTION IN AN ESTUARINE POPULATION OF NEPHTYS HOMBERGII (POLYCHAETA: NEPHTYIDAE),
Southampton Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5E.
W87-07226

EVALUATION OF METHODS FOR SAMPLING VEGETATION AND DELINEATING WETLANDS TRANSITION ZONES IN COASTAL WEST-CENTRAL FLORIDA, JANUARY 1979-MAY 1981,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 7B.
W87-07300

RESERVOIR SYSTEM ANALYSIS FOR WATER QUALITY,
J. H. Duke, D. J. Smith, and R. G. Willey.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as AD-A145 680, Price codes: A03 in paper copy, A01 in microfiche. Army Engineer Technical Paper No. 99, August 1984. 30 p, 5 fig, 1 tab, 30 ref.

Descriptors: *Reservoir operation, *Water quality, *Computer models, *Model studies, Reservoirs, Algorithms, Water temperature, Oxygen.

A reservoir system analysis computer model has been recently developed with the capability to simulate up to 10 reservoirs, 30 control points and 8 water quality parameters. With this model the user can evaluate a 'best' system operation analysis for multipurpose reservoir regulation to obtain target water quality conditions at user specified control points. The model uses a linear programming algorithm to evaluate the 'best' system operation among all the reservoirs and a nonlinear routine for operation of multilevel intakes at any one reservoirs in the system. The user may select to operate the system for a balanced reservoir pool operation and its associated water quality or to allow for a modified for distribution between reservoirs to improve the water quality operation. The water quality routines are capable of analyzing water temperature and up to three conservative and three nonconservative constituents. If at least one of the nonconservative constituents is an oxygen demanding parameter, dissolved oxygen can also be analyzed. (Author's abstract)
W87-07304

MULTISPECTRAL REMOTE SENSING OF INLAND WETLANDS IN SOUTH CAROLINA: SELECTING THE APPROPRIATE SENSOR,
South Carolina Univ., Columbia. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W87-07307

VARIATIONS OF 15N NATURAL ABUNDANCE OF SUSPENDED ORGANIC MATTER IN SHALLOW OCEANIC WATERS,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 2K.
W87-07372

MASS BALANCE MODELING OF HEAVY METALS IN SAGINAW BAY, LAKE HURON,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5B.
W87-07418

COASTAL WETLANDS.
Lewis Publishers, Inc., Chelsea, Michigan. 1986. 286 p. Edited by Harold H. Prince, and Frank M. D'Itri.

Descriptors: *Limnology, *Coastal marshes, *Wetlands, *Conferences, *Michigan, *Great Lakes, Information exchange, Water level, Ecosystem, Research priorities.

This book represents the proceedings of the first 'Great Lakes Coastal Wetlands Colloquium' (November 5-7, 1984, East Lansing, MI). The theme was 'Natural and Manipulated Water Levels in Great Lakes Wetlands'. This material constitutes both Great Lakes wetlands and the state of understanding about them. It is intended to provide fisheries and wildlife biologists, ecologists, aquatic resource managers and planners and environmental scientists information about the coastal wetlands. Objectives of the colloquium were: (1) to provide a forum for the exchange of current information on Great Lakes coastal wetlands, relating in particular to water levels; (2) to establish a network of wetland ecologists and managers in the Great Lakes region; (3) to publish an integrative set of invited and contributed papers on Great Lakes coastal wetlands; and (4) to develop a set of research priorities for Great Lakes wetlands as a base for future research. (See also W87-07432 thru W87-07447) (Lantz-PTT)
W87-07431

EFFECTS OF WATER LEVEL FLUCTUATIONS ON GREAT LAKES COASTAL MARSHES,
Michigan State Univ., East Lansing. Dept. of Zoology.
T. M. Burton.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 3-13, 1 fig, 18 ref. NOAA Grant R/CW-5.

Descriptors: *Limnology, *Wetlands, *Water level fluctuations, *Coastal marshes, *Ecological effects, *Great Lakes, Nutrients, Marshes, Ecosystems, Aquatic plants, Productivity.

Many of the wetlands within the Great Lakes Basin have already been converted to other uses. For example, 47% or 7.5 of 16 million ha of wetlands had been destroyed in Michigan, Minnesota and Wisconsin by 1980. These three states account for 77% of the total wetland areas in glaciated regions of the United States. Most of these wetlands are inland with only a small percentage classified as coastal wetlands. For example, 3.3% of Michigan's 1.3 million ha or 42,840 ha were classified as coastal wetlands. These wetlands are often considered to be modulators of events between land and water. Some of the fluctuations ascribed to them include: (1) acting as a natural filter to protect the water quality of the Great Lakes from nutrients and toxic materials; (2) acting as flood storage areas to reduce the magnitude of flood damage; (3) acting as areas of concentrated primary and secondary production which may serve as food chain support for near-shore Great Lakes communities; (4) acting as recharge areas for groundwater; and (5) serving as habitat and/or nursery areas for fish,, mammals, game and non-game birds as well as invertebrates and ectothermic vertebrates. The present 7-10 year cycle of water level fluctuation results in low periods in lake level which are about 1.75 m lower than the high. The difference between low and high water can have profound effects on the plant communities of coastal marshes. At low water levels, open water decreases from almost 50% of wetland area to about 15%. At high water levels near 177 m in 1975, much of the area of the marsh was occupied by open water/submergent vegetation or emergent vegetation. As water level increases, inundated areas will support considerable emergent and/or submergent productivity including the associated epiphytic plant productivity. As this material rapidly decomposes, the overlying water dissolved oxygen concentrations will decrease, especially in winter when oxygen production by plant photosynthesis is limited. Alternate fluctuations in water level in marshes could result in a situation analogous to that resulting from seasonal re-oxygenation of bottom waters in dimictic eutrophic lakes. Litter accumulation was greatest under lowest water conditions due to known slower decomposition rates in sedge meadows. The impact of water level changes on some bird and mammal populations has been well documented for inland emergent marshes. Few such data are available for the Great

Lakes, and almost no data are available for fish populations. (See also W87-07431) (Lantz-PTT)
W87-07432

ENVIRONMENTAL INFLUENCES ON THE DISTRIBUTION AND COMPOSITION OF WETLANDS IN THE GREAT LAKES BASIN,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
J. W. Geis.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 15-31, 3 fig, 23 ref.

Descriptors: *Limnology, *Coastal marshes, *Great Lakes, *Wetlands, *Distribution analysis, Environmental effects, Lagoons, Islands, Seasonal variation, Snowpack, Ice, Water level, Shoals.

Wetlands are land-water systems which characterize shoreline interfaces of most water bodies. Wetlands are lands where 'the water table is at, near, or above the land surface long enough to promote the formation of hydric soils or support the growth of hydrophytes'. The deep water end of the continuum is marked by the growth limit of emergent macrophytes. It grades into 'deep-water habitats', which are dominated by submerged aquatic macrophytes. The upland limit is exceeded when soils are no longer 'hydric' in classification, and the predominating vegetation is terrestrial rather than hydrophytic. Studies along the eastern shoreline of Lake Ontario and the St. Lawrence River have emphasized the continuity of physical environmental conditions and the intergradation of dominant plant species between adjacent wetland and shallow-water littoral systems. Consequently, a 'wetlands continuum' dominated by aquatic macrophytes, both submerged and emergent, is considered to represent an ecologically useful concept. This continuum spans a range of environments from the deep water limit of submerged aquatic macrophytes to the upland contact. The practical delineation of 'wetlands' and 'deep-water habitats' according to the occurrence of emergent hydrophytes is not seen to be at variance with this concept. Four broad categories of wetland systems are presented: (1) barrier and lagoon systems; (2) embayed wetlands; (3) streamside wetlands; and (4) island and school systems. The effects upon the hydrologic regime of seasonal variation, water level, snowpack and ice are discussed. (See also W87-07431) (Lantz-PTT)
W87-07433

VEGETATION DYNAMICS, BURIED SEEDS, AND WATER LEVEL FLUCTUATIONS ON THE SHORELINES OF THE GREAT LAKES,
Ottawa Univ. (Ontario). Dept. of Biology.
P. A. Keddy, and A. A. Reznicek.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 33-58, 5 fig, 2 tab, 53 ref.

Descriptors: *Limnology, *Great Lakes, *Coastal marshes, *Water level fluctuations, *Wetlands, *Vegetation, Aquatic plants, Water level, Ecosystems.

The existing shoreline vegetation of the Great Lakes Depends upon regular fluctuation in water levels. Fluctuating water levels not only increase the area of shoreline vegetation, but increase the diversity of vegetation types and plant species. High water periods prevent woody vegetation and terrestrial species from occupying sites close to the water and temporarily change the vegetation from wet meadow to emergent species, or from emergent species to floating-leaved and submersed species. High water period also kill dominant species such as cattails (Typha spp.) which might otherwise form extensive monocultures. Low water periods allow many mud flat annuals, meadow and emergent marsh species to regenerate from buried seeds. It appears that buried seed reserves on lakeshores have higher densities than marshes and are more shallow. Any stabilization of water levels would likely reduce marsh area, vegetation diversity and plant species diversity. Priorities for future research are: (1) classification of major vegetation types; (2) establishment of permanent quadrats to monitor changes in species composition with fluctuating water levels; (3) survey of buried seed reserves in different vegetative types of the Great Lakes; (4) comparative studies of flooding tolerance for at least the dominants found in wetlands, with particular emphasis on the depth and duration of flooding required to cause death; (5) investigation of the potential interaction between high water levels, woody plants and the landward limits of marsh vegetation; (6) use of 1-4 to describe cyclic changes in vegetation, in order to predict vegetation responses to different water levels; (7) use of 1-5 to predict potential changes in area of wetlands (or of specific wetland types) if water level fluctuations are increased or decreased; and (8) investigation of effects of seasonal water level fluctuations upon vegetation diversity. (See also W87-07431) (Lantz-PTT)
W87-07434

PRELIMINARY OBSERVATIONS ON THE SEICHE-INDUCED FLUX OF CARBON, NITROGEN AND PHOSPHORUS IN A GREAT LAKES COASTAL MARSH,
Wisconsin Univ.-Green Bay.
P. E. Sager, S. Richman, H. J. Harris, and G. Fewless.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 59-68, 4 fig, 8 ref.

Descriptors: *Limnology, *Wetlands, *Seiches, *Cycling nutrients, *Carbon, *Nitrogen, *Phosphorus, *Coastal marshes, *Great Lakes, *Green Bay, *Wisconsin, Outwelling, Marshes, Nutrients, Water level fluctuations, Zooplankton.

The exchange of inorganic and organic materials between wetlands and adjacent waters has been studied extensively in saltwater systems. Investigations on freshwater marshes have also been made; however, few such systems lend themselves to flux measurements of the type made on estuarine salt marshes. Hence, much of what is understood about nutrient dynamics in coastal marshes comes from salt marsh studies where a more extensive literature has accumulated. Recent reviews suggest that the long standing paradigm of outwelling of biologically important substances, dissolved and particulate, from coastal marshes cannot be supported. A variety of physical factors including the geomorphology of the marsh drainage, the areas of marsh and adjacent coastal waters and the magnitude of the water flux appear to be important determinants of whether specific wetlands show significant export or import of dissolved or particulate substances. Previous studies observed that coastal marshes appear to annually export both dissolved and particulate organic carbon, dissolved organic nitrogen and dissolved phosphorus. The potential significance of these exports is suggested to be a function of the relative sizes of marsh and coastal water systems; yet in general and based on a variety of study areas, the magnitudes of the exports do not appear to have great biological importance in the adjacent waters. The coastal marshes in Green Bay offer an opportunity to test in a freshwater system the paradigm arising from salt marsh studies and to determine the contribution, if any, these coastal marshes make to the lacustrine ecosystem. This paper is a preliminary report on a study of a segment of Peter's Marsh on lower Green Bay. The study was initiated in June, 1983. The object of the investigation is to assess the flux of carbon, nitrogen and phosphorus between the marsh and the waters of Green Bay and determine the potential value of exported particulates for filter-feeding zooplankton species of the adjacent open waters. The study was designed to take advantage of periodic water level fluctuations associated with a standing wave or surface seiche in the bay. (See also W87-07431) (Lantz-PTT)
W87-07435

NUTRIENT CYCLING BY WETLANDS AND POSSIBLE EFFECTS OF WATER LEVELS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. L. King.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 69-86, 5 fig, 39 ref.

Descriptors: *Limnology, *Cycling nutrients, *Wetlands, *Water levels, Heterogeneity, Seasonal variation, Nutrients, Photosynthesis, Plankton, Aquatic plants, Nitrogen, Hydrogen ion concentration, Ammonia, Phosphorus.

Wetlands are: (1) an extremely heterogeneous group of systems across the face of this planet and even over the extent of North America; (2) they are pulse-fed on temporal cycles which are neither regular in occurrence nor volume, nor do these pulses uniformly impact the recipient wetlands; (3) each individual wetland is spatially heterogeneous in respect to physical factors such as water regime, substrate type and nutrient chemistry and such biological factors as species and community distribution and relative biological activity; and (4) between wetlands, there is seasonal variation in such critical physical factors as climatology and hydrology and biological factors as production rates and standing crop. Depending on where and when data are collected from wetlands, information can be accumulated which indicates that any given wetland is either a sink or a source for almost any nutrient. But, even in a single season, there will be a large variability in nutrient flux in most wetlands. Photosynthesis by the mix of submerged, emergent, planktonic and periphytic plants increases both the dissolved and particulate organic content of the wetland. Increased supply of energy-rich organics allows accelerated respiratory activity in the warming increasing the transformation rate of nitrogen from one chemical species to another. Increased water detention time increases the probability of establishing sufficiently reducing conditions to allow denitrification and the loss of nitrogen to the atmosphere. Decreased water flow rate through a wetland also is accompanied by increased photosynthetic carbon extraction from the alkalinity and the concomitant rise in pH. This pH rise can lead to rapid losses of ammonia to the atmosphere. Phosphorus dynamics in wetlands are complex, and involve a variety of shifts in chemical equilibria, precipitation kinetics and a variety of biological interactions. Much of the dynamics of phosphorus can be traced to interactions between plant activity and hydrology and type and amount of sediments added to the wetland. (Seealso W87-07431) (Lantz-PTT)
W87-07436

AVIAN WETLAND HABITAT FUNCTIONS AFFECTED BY WATER LEVEL FLUCTUATIONS,
Long Point Bird Observatory, Port Rowan (Ontario).
M. K. McNicholl.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 87-98, 38 ref.

Descriptors: *Limnology, *Great Lakes, *Food habits, *Birds, *Wetlands, *Water level fluctuations, Ecosystems, Ecological effects, Nesting, Migration, Water level, Marshes.

Wetlands provide feeding habitat for a wide variety of birds year round and seasonal habitats for nesting, moulting, migration stop-over sites, and wintering sites. Effects on birds of fluctuations in water levels on suitability of a particular wetland for feeding will be manifest primarily through effects on the food supply or even less directly through effects on the habitat used by the food organism(s) in question. Species nesting in highly stable habitats will generally be less affected by fluctuations in water level, but those likely to be affected have evolved a wide array by adaptations to frequent change. Migration and wintering site fidelity may be more important than previously realized, and the suitability of sites could be profoundly influenced by changes in water levels. In spite of the fact that most is known about nesting birds, there are still relatively few studies of bird communities in wetlands over long periods of time, and long-term effects of water fluctuations on birds therein can be predicted only at a generalized level until such studies are done. At the species level, the basic breeding biology of most species of marsh bird remains to be sorted out, the red-winged blackbird and some ducks being the only species for which many studies are available to date. Should water level fluctuations be found to be affecting birds in the Great Lakes area adversely, experiments on remedial measures such as nest

platforms would be advised. (See also W87-07431) (Lantz-PTT)
W87-07437

AVIAN COMMUNITIES IN CONTROLLED AND UNCONTROLLED GREAT LAKES WETLANDS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
H. H. Prince.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 99-119, 2 fig, 13 tab, 11 ref.

Descriptors: *Limnology, *Birds, *Great Lakes, *Wetlands, Monitoring, Water level fluctuations, Marsh wren, Red-winged blackbird, Marshes, Ecosystems, Aquatic plants, Species composition.

Avian activities on four 47 ha to 200 ha wetland study areas were monitored over a four-year period. Two of the areas were diked so water levels could be controlled while the other two were subject to natural water level fluctuations. Nests of twenty species of birds were located in the study areas with eight species being well distributed. Red-winged blackbirds (Agelaius phoeniucesus) and marsh wren (Cistothorus palustris) were the most common species. Both nest density and number of species increased as the percentage of open water decreased in the wetlands. Wetland study areas with poorly developed communities of submersed plants did not have as many species nesting and had more herons present in late summer compared to areas with well developed submersed plant communities. Rails responded to taped calls throughout the summer, and this technique may be useful for evaluating abundance of birds and productivity. (See also W87-07431) (Author's abstract)
W87-07438

RELATIONSHIPS OF WATER LEVEL FLUCTUATIONS AND FISH,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
C. R. Liston, and S. Chubb.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 121-140, 6 fig, 1 tab, 48 ref.

Descriptors: *Limnology, fluctuations, *Fish, *Ecological effects, *Great Lakes, *Wetlands, Productivity, Nutrients, Aquatic plants, Water level, Lakes, Channels, Pike, Sunfish, Coastal marshes, Spawning, Hatching.

Abnormally high water levels during spring may have significant effects, such as: (1) shoreline terrestrial vegetation is flooded which initiates dying and decomposition and subsequent release of nutrients, thus increasing the water productivity; (2) fish food organisms such as insects and earthworms are quickly added to the water; (3) new cover and habitat for shoreline fish species is added; and (4) an area of water is created that is sparsely populated with fish, which should stimulate reproduction and growth as fish attempt to fill the 'void'. Certain species of fish, especially largemouth bass, do best when water level increases occur immediately before, during, and for a short time following the spawning and nursery period. Though long-term data on standing stocks of fish in relation to changing water levels are rare, especially in the Great Lakes area, some data from reservoirs appear to show direct benefits of high water levels regarding production of young-of-the-year (YOY) fish. Brief, repetitive water level changes in shoreline wetlands near commercial shipping lanes, influenced by passing ships, have been going on for decades. Recent data show that as much as a 70 cm change in wetland water level may be created by passing vessels in channels. Further, larval fishes and drifting invertebrates may be drawn out of the wetlands during drawdown periods. The effects of these frequent alterations of wetlands on fish communities are not well understood. It is hypothesized that not only high, but stable spring/early summer water levels are important to the Pentwater fish community, as studies from reservoirs have indicated that production of YOY sunfish is negatively affected when water levels fluctuate during the spawning/nursery periods. This should also be true for northern pike, a species spawning in the shallowest, most vegetated portion of the marsh. Unstable, fluctuating water levels may also alter the composition of benthic macroinvertebrates in littoral zones, favoring oligochaetes and chironomids over important prey groups. Such changes may account for some of the lower productivities of sunfishes observed by other authors, and may be attributable to changes in substrate, specifically to the accumulation of silt and loss of vascular macrophytes. Water level fluctuations may also alter temperature regimes in littoral zones, thus influencing fish spawning periods and rates of food production. (See also W87-07431) (Lantz-PTT)
W87-07439

SIMPLIFIED COMPUTATION OF WETLAND VEGETATION CYCLES,
Michigan Univ., Ann Arbor. Wetlands Ecosystem Research Group.
R. H. Kadlec, and D. E. Hammer.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 141-157, 4 fig, 5 tab, 10 ref.

Descriptors: *Limnology, *Great Lakes, *Wetlands, *Vegetation, *Mathematical studies, *Houghton Lake, *Biomass, Nitrogen, Phosphorus, Roots, Computer program, Seasonal variation.

Based on data from the Houghton Lake Porter Ranch Wetland, an accounting of biomass, nitrogen and phosphorus is presented, for the natural stationary repetitive state. The budgets for the wetland are constructed from data on ten compartments; annual and woody live biomass, roots, standing dead, annual and woody litter, three soil layers and surface water. A simple set of empirical rules for biomass behavior provide a reasonable description of seasonal variations. A simple computer program allows the calculation of annual cycles, based on material supplies and constraints, and the most commonly measured variables. (See also W87-07431) (Author's abstract)
W87-07440

WETLAND VALUATION: POLICY VERSUS PERCEPTIONS,
Eastern Michigan Univ., Ypsilanti.
P. B. Weber.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 159-174, 1 fig, 4 tab, 12 ref.

Descriptors: *Model studies, *Wetlands, *Value, *Public policy, *Cost-benefit analysis, Economic aspects, Land appraisals.

Traditional wetland valuation strategies have been based upon financial models expanded to frame such resource economics issues as valuing the imputed cost of environmental policy alternatives. These cost-benefit analyses utilize present value techniques to examine discounted cash flows, payback periods or profitability indices as a method to establish the comparative advantage of land use alternatives. Finance-based models are credible evaluation tools for investment alternatives which possess identifiable cash flows or streams of benefit. However, their applicability to land use problems which require estimation of social value rather than private value is less than complete because of at least two shortcomings: (1) traditional financial models offer no provision for the measurement or estimation of affective, nonmonetary values attached to alternative uses; and (2) the comparison of benefit streams or returns on investment are estimates of the variable costs and returns to the parcel in use, and do not reflect the land owner's perceptions of the worth of a parcel (as distinct from its market value). It is common knowledge that property holders may invest disproportionate sums in a parcel relative to their expected returns on that investment. The attempts of federal and state agencies to establish a socially optimal balance of wetlands throughout the Upper Midwest region is but one case in point. Cash estimates of private landowner returns to wetland drainage included increased crop sales, decreased nuisance or avoidance costs and a component for the net influence of intangibles. Increased crop sales were estimated using a present value algorithm based upon discounted cash flow. Extensive computations were based on variable costs of production (nc' return on land values). The cost-benefit analysis fails to account, literally, for owned worth of the land, in addition to the potential risks stimulating interest in wetland drainage. One alternative, of course, would be to simply increase monetary incentives gradually until participation was optimal. However, such tactics tend to elicit counterstrategies on the part of landowners who may attempt to estimate 'peak' payoffs and drive the incentives payment higher in an artificial market. It would be far preferable strategically, and in terms of total social cost, to assess an adequate cash value for nonmonetary considerations and shift the incentive structure in a one-time adjustment, rather than to invoke a bidding posture. (See also W87-07431) (Lantz-PTT)
W87-07441

ONTARIO'S WETLAND EVALUATION SYSTEM WITH REFERENCE TO SOME GREAT LAKES COASTAL WETLANDS,
Canadian Wildlife Service, Ottawa (Ontario).
E. Bottomley.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 175-185, 3 fig, 3 tab, 13 ref.

Descriptors: *Wetlands, *Ontario, *Great Lakes, *Coastal marshes, *Value, *Lake St. Clair, *Second Marsh, *Lake Erie, *Lake Ontario, Land appraisal, Economic aspects, Marshes, Swamps, Fens, Bogs, Statistical analysis, Classification.

'An Evaluation System for Wetlands of Ontario South of the Precambrian Shelf' was produced jointly by Environment Canada and the Ontario Ministry of Natural Resources. The evaluation system is designed to numerically quantify wetland values to permit comparison of wetlands relative to each other. The evaluation system is broad in perspective: it can be applied to four wetland types -- marshes, swamps, fens and bogs -- and it encompasses four categories of wetland values -- biological, social, hydrological and special features. Vigorous field testing and statistical analysis of evaluation results showed that the system is reproducible, and it appears to produce a fairly accurate ranking of wetlands. Marshes, swamps and bogs scored fairly highly for the Biological Component; Social Component scores covered a range of values for all wetland types; Hydrological Component scores for marshes were consistently low whereas bogs obtained much higher scores; and Special Features Component scores were high for many wetlands including a large number of marshes. Wetlands are grouped into seven classes on the basis of evaluation scores, with Class 1 and 2 wetlands being the most valuable. Of the 30 Great Lakes coastal wetlands evaluated on Lakes Ontario, Erie and St. Clair, 19 (63%) were Class 1 and 2 wetlands, and 90% were Class 3, 2 or 1. The high performance of these coastal wetlands derives from their strengths in the Biological and Special Features Components; Hydrological Component scores were very low. Details of the scoring system are illustrated using Second Marsh (Oshawa, Ontario) as an example. (See also W87-07431) (Author's abstract)
W87-07442

CHARACTERISTICS OF PROVINCIALLY SIGNIFICANT WETLANDS AS ASSESSED BY THE ONTARIO WETLAND EVALUATION SYSTEM,
Ontario Ministry of Natural Resources, Toronto. Wildlife Branch.
V. Glooschenko.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 187-199, 4 fig, 4 tab, 25 ref.

Descriptors: *Wetlands, *Ontario, *Classification, Wildlife, Biological properties, Social impacts, Hydrological properties, Swamps, Marshes, Lakes, Waterfowl, Fish.

Southern Ontario wetland loss is associated with an accompanying decline in wildlife populations. An evaluation system for wetlands in southern Ontario developed by the Ontario Ministry of Natural Resources nd the Canadian Wildlife Service,

Environment Canada is being used by the provincial government to examine remaining wetlands. Wetlands are ranked by biological, social, hydrological and special features values. By the end of 1984, 700 wetlands had been evaluated across southern Ontario; 94 wetlands were ranked provincially significant (Class 1 and 2) and 84 were regionally significant (Class 3). Ranking of wetlands will be used in guidelines for wetland management. Characteristics of provincially significant wetlands are discussed by wetland type and physiographic site with reference to their evaluation scores. The hydrological component had considerable influence on the scores of inland swamps and marshes while it contributed little to scores for lakeshore wetlands. The special features component was very important in determining class rank. Important differences in special features subcomponent scores between swamps and marshes were observed; these subcomponents include breeding and feeding by provincially significant animals, water cover for wildlife, waterfowl staging and fish spawning and rearing. (See also W87-07431) (Author's abstract)
W87-07443

WETLAND THREATS AND LOSSES IN LAKE ST. CLAIR,
Canadian Wildlife Service, London (Ontario).
G. B. McCullough.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 201-208, 1 fig, 2 tab, 4 ref.

Descriptors: *Wetlands, *Lake St. Clair, *Ontario, *Ecological effects, *Lake Erie, *Land appraisal, *Great Lakes, Geese, Ducks, Lakes, Drainage, Taxes, Marshes, Agriculture.

In Ontario, south of James Bay, the most extensive and highest quality habitat for migrating waterfowl is provided by the shoreline marshes of Lakes Erie and St. Clair. Canadian Wildlife Service studies have shown that the wetlands associated with the eastern shore of Lake St. Clair are presently the most important Ontario staging areas for mallards, black ducks, Canada geese and tundra swans. From 1965 to 1984, 30% of the privately owned marshland along the eastern shore of Lake St. Clair has been destroyed -- a loss of 1,064 ha. Drainage for agriculture accounted for 92% of the loss. Canadian Wildlife Service studies have shown a 79% decline in the use of this area by true marsh-dwelling waterfowl during the spring and 41% decline in the autumn. In 1984, a new and greater threat to the remaining marshland emerged -- property tax reassessments. These Provincially administered reassessments have resulted in tax increases of 65% and higher on marshland. If the same property were drained and farmed, the taxes would be about half as much, and government tax subsidies would be available to further reduce the cost to the landowner. Pressure to convert these valuable marshes to agricultural land combined with the recent property reassessment and dramatic increase in taxes will only work against the efforts of the Canadian Wildlife Service and others to protect and preserve the wetlands of Lake St. Clair. More marshes will be destroyed and converted to farmland. North American waterfowl will suffer. (See also W87-07431) (Author's abstract)
W87-07444

HUMAN INTERFERENCE WITH NATURAL WATER LEVEL REGIMES IN THE CONTEXT OF OTHER CULTURAL STRESSES ON GREAT LAKES WETLANDS,
Federation of Ontario Naturalists, Don Mills.
N. J. Patterson, and T. H. Whillans.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 209-251, 6 tab, 94 ref.

Descriptors: *Water levels, *Limnology, *Great Lakes, *Wetlands, *Stress analysis, Cultural control, Dikes, Channels, Ecosystems, Reviews.

Water level regime is but one of many manageable factors which could influence the condition or extent of a Great Lakes wetland. Some factors which could affect water levels such as river discharge into a wetland, diversion of lake water around a wetland, isolation from natural hydrologic influence (diking) or channelization through a wetland could also have independent influence and are subjects of considerable human tampering. It is therefore advisable to consider water level regime and human interference with it in the context of other human-engendered problems in Great Lakes wetlands. There are at least three major aspects which merit examination: (1) comparison of causal factors in order to isolate similarities among causes (and implied solutions); (2) contrast of stresses (biological, chemical or physical perturbation) and of long-term responses in order to clarify the ecosystemic significance of water level regime (and implied priority for action); and (3) investigation of interaction among causes, among stresses and among long-term responses in order to specify synergisms and antagonisms (and implied interpretation of (1) and (2)). The aspects (1) and (2) have been examined to a degree for the Great Lakes in general, for certain wetland-rich ecosystems within the Great Lakes, and for wetlands in general. This review is based in large part upon those studies. (See also W87-07431) (Lantz-PTT)
W87-07445

CONTROL OF CATTAIL AND BULRUSH BY CUTTING AND FLOODING,
Ducks Unlimited Canada, Winnipeg (Manitoba).
For primary bibliographic entry see Field 4A.
W87-07446

MARSH MANAGEMENT BY WATER LEVEL MANIPULATION OR OTHER NATURAL TECHNIQUES: A COMMUNITY APPROACH,
Guelph Univ. (Ontario). Dept. of Zoology.
J. P. Ball.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 263-277, 50 ref.

Descriptors: *Marshes, *Water level, *Ecosystems, *Wetlands, Conservation, Aquatic habitats.

As a result of the loss of wetland habitats, many public interest groups, conservation agencies and professional organizations agree on the need to preserve wetlands. Beyond this agreement, however, the diverse value systems of these groups lead to disagreement as to what should be done with these marshes. Some groups advocate simple preservation of wetlands in their existing state, while others wish to manage wetlands for the production of certain species or taxa. Some of these disagreements may be unavoidable, but perhaps a single-species philosophy of management has exacerbated these differences of opinion. A community or multi-species approach to wetland management, however, may more likely satisfy the aims of these various interest groups. This paper discusses such an approach to wetland management and shows that techniques which simulate natural events can be employed to simultaneously satisfy many of the interests of these various groups. (See W87-07431) (Lantz-PTT)
W87-07447

OCCURRENCE AND SPECIATION OF ORGANOMETALLIC COMPOUNDS IN FRESHWATER SYSTEMS,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W87-07468

25,000-YEAR HISTORY FOR LAKE VICTORIA, EAST AFRICA, AND SOME COMMENTS ON ITS SIGNIFICANCE FOR THE EVOLUTION OF CICHLID FISHES,
Duke Univ., Durham, NC. Dept. of Zoology.
J. C. Stager, P. N. Reinthal, and D. A. Livingstone.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 15-19, February 1986. 2 fig, 1 tab, 22 ref.

Descriptors: *Sediment cores, *Lake Victoria, *Limnology, *Diatoms, *History, *Cichlid, Sediments, Fish, Lakes, Carbonates, Ponds.

Microfossil and X-ray analyses of sediment cores from Lake Victoria, East Africa, reveal a history of dramatically shifting environmental conditions over the last 25,000 years. The diatom record of a 10 m core collected from beneath 66 m of water at an offshore station extends the known history of the lake 10,000 years beyond the published records from Pilkington Bay and Damba Channel, and shows that maximal late Pleistocene aridity occurred between 15,000 and 13,000 BP. Lack of precipitated carbonates in the offshore sediments suggests that the lake remained relatively dilute throughout the period of record. There is no evidence that the lake level fell low enough to confine fishes to refugia in small isolated ponds or around river mouths. (Author's abstract)
W87-07484

SEASONAL VARIATION IN THE ABUNDANCE AND HETEROTROPHIC ACTIVITY OF SUSPENDED BACTERIA IN TWO LOWLAND RIVERS,
Hull Univ. (England). Dept. of Plant Biology.
R. Goulder.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 21-37, February 1986. 6 fig, 3 tab, 63 ref.

Descriptors: *Seasonal variation, *Suspended bacteria, *Lowland rivers, *Heterotrophic activity, Bacteria, Rivers, Regression analysis, Turnover time.

Water samples were collected over two years from the Yorkshire Ouse and Yorkshire Derwent and the following were measured: (i) concentration of directly-counted bacteria (free-living and particle-bound), (ii) concentration of colony-forming units, (iii) bacterial heterotrophic activity (turnover rate for glucose assimilation), (iv) specific activity (turnover rate per bacterium), (v) a range of environmental variables. The abundance and activity of suspended bacteria showed similar seasonal periodicities in both rivers. Free-living bacteria were usually more numerous than particle-bound bacteria; low concentration of free-living bacteria and maxima of particle-bound bacteria usualiy occurred in winter. Concentration of colony-forming units varied irregularly, but lowest levels were found in summer. Turnover rate and turnover rate per bacterium showed distinct summer maxima. Multiple-regression analysis was used to relate bacterial variables to subsets (chosen by factor analysis) of environmental variables; up to 89% of variation in bacterial variables was related to the combined effects of variation by variables in the chosen subsets. (Author's abstract)
W87-07485

RATES OF AMMONIA RELEASE FROM SEDIMENTS BY CHIRONOMID LARVAE,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
I. Tatrai.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 61-66, February 1986. 5 fig, 1 tab, 15 ref.

Descriptors: *Ammonia, *Sediments, *Limnology, *Midges, *Larvae, Lake Balaton, Metabolism, Temperature effects, Excretion, Mineralization, Lakes.

Microcosms of Lake Balaton mud and sterilized sand and aerated water were used to evaluate ammonia increments in the overlying water as influenced by chironomid density and temperature. In the two approaches, the effects of sediment disturbance and metabolic excretion of chironomids were measured. The activity of larvae increased the ammonia content of the overlying water at temperatures above 10 C. A rise of temperature to 20 C resulted in a 5-20-fold increase in ammonia release in both systems with chironomids. At 10 C combined effects of sediment disturbance and of excretion produced lower release rates than did excretion rates alone (mud-water v. sand-water treatments). At higher temperatures (15 and 20 C) release rates of ammonia by sediment disturbance plus excretion were higher than excretion rates alone. Ammonia excretion contributed significantly to the total release at each temperature. Metabolic mineralization of nitrogen compounds appears to be an important mechanism contributing

to nitrogen regeneration from aerobic lake sediments. High N:P ratio (14:1) of chironomid excretion materials supports this interpretation. (Author's abstract)
W87-07486

SPATIAL AND TEMPORAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF STREAMS OF THE NORTHERN JARRAH FOREST, WESTERN AUSTRALIA: COMMUNITY STRUCTURE,
Western Australia Univ., Nedlands. Dept. of Zoology.
S. E. Bunn, D. H. Edward, and N. R. Loneragan.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 67-91, February 1986. 12 fig, 7 tab, 54 ref, append.

Descriptors: *Species composition, *Streams, *Macroinvertebrates, *Limnology, Streamflow, Seasonal variation, Australia, Taxonomy, Invertebrates, Regression analysis, Velocity, Cations, Geology, Catchments.

Streams of the northern jarrah forest, Western Australia, were sampled at twelve sites from December 1981 to December 1982 to examine spatial and temporal changes in the structure of the macroinvertebrate community. The climate of this region is quite predictable by Australian standards and each year a hot, dry summer is followed by a mild, wet winter. Highest stream discharge occurs during winter (June-November) reducing to negligible flow over late summer and autumn (January-May). The low flows in summer were associated with warm water, lower dissolved oxygen, increased concentrations of cations and, in many cases, lower pH. Temporal changes in abundance, diversity and evenness indicated that the invertebrate fauna became dominated by a few taxa during the summer months. Major spatial and temporal changes in the composition of the fauna were detected by classification and ordination. Summer and winter faunas were identified at most sites and were clearly associated with the seasonal changes in the physical and chemical environment. This seasonality is not typical of stream systems previously studied in Australia. Large spatial differences also occurred over small distances among sites in two similar-sized forested catchments. Multiple discriminant analysis and stepwise multiple regression analysis showed that velocity and depth were highly associated with the observed temporal changes in the fauna, though other variables, including concentrations of cations and water temperature, were also important. Spatial differences were correlated with concentrations of cations which may simply reflect differences in the geologies of the catchments. (Author's abstract)
W87-07487

PEAT AND PEAT WATER CHEMISTRY OF A FLOOD-PLAIN FEN IN BROADLAND, NORFOLK, U.K.,
Sheffield Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2K.
W87-07488

MICROHABITAT SELECTION BY A STREAM-DWELLING AMPHIPOD: A MULTIVARIATE ANALYSIS APPROACH,
Toronto Univ. (Ontario). Div. of Life Sciences.
D. D. Williams, and K. A. Moore.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 115-122, February 1986. 3 fig, 3 tab, 17 ref.

Descriptors: *Multivariate analysis, *Colonization, *Amphipods, *Limnology, *Streams, *Microhabitats, Ontario, Substrates, Nutrients, Silt, Streamflow, Biomass, Animal behavior.

Colonization of microhabitat implants by the amphipod Gammarus pseudolimnaeus in a small southern Ontario stream was studied in order to analyze the factors controlling habitat selection. The variables substrate particle size, current speed, presence of food and light were used in an analysis of covariance, with percentage weight of organic matter of silt and percentage interstitial space occluded by silt as the covariates. Greatest numbers of amphipods settled on microhabitats featuring large substrate particles, no current and presence of food. There was also a positive relationship between total numbers and the volume of silt deposited on the microhabitats by the stream; small quantities of silt had a beneficial effect on colonization but larger quantities became detrimental. The change from a positive effect occurred at approximately 25% occlusion of the interstitial space in large gravel (chi diameter = 3.2 cm) and at approximately 55% occlusion in small gravel (chi diameter = 3.4 cm). Large animals (6-16.0 mm long) were found predominantly in microhabitats featuring food and large substrate. Medium-sized animals (3-6.0 mm) were most commonly associated with no current and presence of food, and were positively affected by the amount of silt but, at the same time, were negatively affected by increasing occlusion of interstitial spaces by silt. Numbers of small Gammarus (<3.0 mm) were affected only by silt and in a similar manner to medium-sized animals. Amphipod biomass was greatest in microhabitats featuring food and no current. Previous data on the behavior of this species in laboratory stream-tanks are compared with the microhabitat selections seen. (Author's abstract)
W87-07489

STREAM HYDRAULICS AS A MAJOR DETERMINANT OF BENTHIC INVERTEBRATE ZONATION PATTERNS,
Karlsruhe Univ. (Germany, F.R.). Zoologisches Inst.
B. Statzner, and B. Higler.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 127-139, February 1986. 8 fig, 1 tab, 67 ref.

Descriptors: *Streamflow, *Zonation, *Benthic fauna, *Streams, *Limnology, Stream hydraulics, Invertebrates, Zones, Upstream, Downstream.

Studies on the zonation of benthic fauna in fourteen streams situated in a variety of latitudes from Alaska to New Zealand were evaluated. It is suggested that physical characteristics of flow ('stream hydraulics') are the most important environmental factor governing the zonation of stream benthos on a world-wide scale. From the source to the mouth of a stream, zones of transition in 'stream hydraulics' occur, to which the general pattern of stream invertebrate assemblages can be related. In these zones benthic community stability and resilience must be different from those upstream and downstream of the hydraulic transition zones. (Author's abstract)
W87-07490

STRUCTURAL AND FUNCTIONAL ASPECTS OF SUCCESSION IN SOUTHEASTERN FLOODPLAIN FORESTS FOLLOWING A MAJOR DISTURBANCE,
Savannah River Ecology Lab., Aiken, SC.
R. M. Muzika, J. B. Gladden, and J. D. Haddock.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 1-9, January 1987. 5 tab, 26 ref.
DOE Contract DE-AC09-76SR00819.

Descriptors: *Thermal stress, *Limnology, *Temperature effects, *Flood plains, *Succession, *Vegetation regrowth, Plant growth, Stress, Nuclear reactors, Effluents, Steel Creek, Savannah River Plant, Productivity, Biomass, Flooding, Flood frequency, Primary productivity, Litter.

Floodplain vegetation was studied after 15 years of succession following thermal stress caused by the effluents released from nuclear production reactors between 1954-1968 that destroyed the entire vegetative cover. Four sites in the Steel Creek drainage, a second-order stream on the Savannah River Plant, were chosen to represent posthermal recovering and thermally undisturbed areas of the riverine and stream floodplains. Estimates of aboveground biomass and aboveground net primary productivity (NPP) indicate that these two floodplains are recovering similarly. Salix nigra and S. caroliniana dominated both sites, yet overall species composition differed, probably because of contrasting hydroperiod, i.e., the duration and timing of flooding events differed. Both of these recovering floodplains had 7% of the wood biomass of undisturbed sites on similar floodplain types. Litterfall was similar among all sites. Aboveground NPP for recovering sites was 814.9 and 944.4 grams/sq m/year at the stream and riverine sites, respectively. (Wood-PTT)
W87-07515

CHANGES IN SOLUBLE NUTRIENTS OF PRAIRIE RIPARIAN VEGETATION DURING DECOMPOSITION ON A FLOODPLAIN,
Savannah River Ecology Lab., Aiken, SC.
J. V. McArthur, and G. R. Marzolf.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 26-34, January 1987. 3 fig, 3 tab, 20 ref.
DOE Contract DE-AC0-76SR0-819.

Descriptors: *Limnology, *Flood plains, *Streams, *Watersheds, *Nutrients, Vegetation, Decomposition, Grasses, Prairies, Grasslands, Magnesium, Potassium, Calcium, Sodium, Organic carbon, Nitrogen, Leaves, Leachates, Kansas, Kings Creek.

Measurements of concentration of Mg, K, Ca, Na, dissolved organic carbon (DOC) and total N were made on the soluble fraction of leaves decomposing on the floodplain of a prairie stream. The leaf material was collected in the Kings Creek watershed on the Konza Prairie Research Natural Area in the Flint Hills of northeastern Kansas near Manhattan at monthly intervals beginning in December 1981 and ending in July 1982. Differences in the concentrations of these nutrients depended on the species of leaf material and location on the floodplain. Leaves placed in the grassland reach of the stream had lower concentrations of soluble nutrients than leaves placed in the gallery forest. Correlations between concentration of leachable nutrients and cumulative precipitation or DOC were both positive and negative. Species differed in rank order of the nutrient concentration in leachates of their leaves. Bluestem and sycamore leaf leachate concentrations were low, whereas hackberry, elm, and bur oak leachate concentrations were relatively high. (Wood-PTT)
W87-07516

SPAWNING PERIODICITY OF THE ASIATIC CLAM CORBICULA FLUMINEA IN THE NEW RIVER, VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
F. G. Doherty, D. S. Cherry, and J. Cairns.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 71-82, January 1987. 4 fig, 1 tab, 42 ref.

Descriptors: *Limnology, *New River, *Rivers, *Clams, *Spawning, Seasonal variation, Mollusks, Virginia, Larvae, Sediments, Data acquisition, Water temperature, Physical properties, Temperature, Discharge measurement.

Spawning periodicity of the Asiatic clam Corbicula fluminea in the New River, Virginia, is reported. Numbers of newly recruited larvae in the New River sediment, number and life stage of larvae naturally released and collected from adults held in the laboratory, and presence of developing veligers within the brood chambers of sacrificed adults were collected weekly from May to December 1984. Abiotic data collected consist of mean weekly water temperatures, daily total daylight hours for the western Virginia vicinity and mean daily discharge rates. Density of larvae in sediment, total numbers of larvae collected from the laboratory-held adults, and brood chamber condition are all highly similar in timing, duration and intensity of spawning effort. There were three major peaks in larval abundance - late spring, midsummer and early autumn. These observations do not coincide with previously reported patterns of spring and autumn reproductive peaks by Corbicula fluminea. (Author's abstract)
W87-07518

EFFECTS OF THERMAL REGIME ON SIZE, GROWTH RATES AND EMERGENCE OF TWO SPECIES OF STONEFLIES (PLECOPTERA: TAENIOPTERYGIDAE, PTERONARCYIDAE) IN THE FLATHEAD RIVER, MONTANA,

Montana Univ., Bigfork. Biological Station.
S. A. Perry, W. B. Perry, and J. A. Stanford.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 83-93, January 1987. 3 fig, 1 tab, 35 ref.

Descriptors: *Limnology, *Stoneflies, *Temperature effects, *Thermal regime, *Rivers, *Aquatic insects, *Growth rates, Water temperatures, Flathead River, Montana, Dams, Hypolimnial-release dams, Environmental effects, Population density, Weather patterns.

The life histories of two species of stoneflies were compared in adjacent unregulated and partially regulated reaches of the Flathead River in northwestern Montana. Approximately one-third of the discharge in the partially regulated reach is from the South Fork, which is controlled by a hypolimnial-release dam. Responses of winter-emerging Taenionema pacificum to altered environmental conditions included larger nymphal sizes and altered growth rates and emergence times. Pteronarcella badia, a late-spring emerger, responded with differences in population densities and larger nymphal sizes, but not with significantly altered growth rates or emergence times. Monthly mean temperatures were positively correlated with mean specific growth rates of P. badia but not with T. pacificum. Specific growth rates (calculated from measurements of interocular distance) ranged from -0.2% to 2.6%/day for T. pacificum and from -0.1% to 2.5%/day for P. badia. Growth rates differed during the two years of the study as a result of varying discharge regimes and weather patterns. (Author's abstract)
W87-07519

PREY SIZE SELECTIVITY AND FOOD PARTITIONING AMONG ZOOPLANKTIVOROUS AGE-0 FISHES IN LAKE FRANCIS CASE, SOUTH DAKOTA,
South Dakota Dept. of Game, Fish and Parks, Yankton.
P. H. Michaletz, D. G. Unkenholz, and C. C. Stone.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 126-138, January 1987. 4 fig, 2 tab, 50 ref.

Descriptors: *Predation, *Limnology, *Fish food, *Foods, *Zooplankton, *Reservoirs, *Fish food organisms, *Lake Francis Case, Fish, Walleyes, Perch, Bass, Shad, Fish growth, Fish physiology, South Dakota, Missouri River.

Zooplankton prey selection and food partitioning were examined among cohabiting age-0 walleyes Stizostedion vitreum, yellow perch Perca flavescens, white bass Morone chrysops and gizzard shad Dorosoma cepedianum. Age-0 fish were sampled at irregular intervals from 7 July to 29 September 1982 and weekly from 16 May to 15 August 1983 from Lake Francis Case, a large mainstem Missouri River reservoir in South Dakota. It was found that as the fish grew, they consumed progressively larger zooplankton prey. Prey size appeared to be the primary factor governing zooplankton prey selection by the visual predators - walleyes, yellow perch and white bass. Prey evasiveness was not important in prey selection for the visual predators but was important for the nonvisual predator, the gizzard shad. Age-0 fish partitioned food resources by prey size. Walleyes usually selected the largest prey at a given time, followed by white bass, yellow perch and gizzard shad. Diet overlap was highest between yellow perch and white bass, which had the most similar mouth gaps. (Wood-PTT)
W87-07520

COMPARISON OF SEASONAL LIPID CHANGES IN TWO POPULATIONS OF BROOK CHAR (SALVELINUS FONTINALIS),
Clarion Univ. of Pennsylvania. Dept. of Biology.
G. B. Nelson, and R. McPherson.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 139-147, January 1987. 5 fig, 27 ref.

Descriptors: *Limnology, *Reproduction, *Lipids, *Seasonal variation, *Char, *Streams, *Fish physiology, Fish, Fish populations, Pennsylvania, Cherry run, Fishing Creek, Populations, Correlation analysis, Fish eggs.

Seasonal variations in lipid storage and use in female brook char Salvelinus fontinalis were compared between two native populations from contrasting central Pennsylvania streams. One population was sampled in Cherry Run, a freestone stream with low productivity. The other sampled population was from Fishing Creek, a limestone stream with high productivity. Results were correlated to reproduction. Fecundity differed between the populations. Char from Fishing Creek produced significantly more eggs. Both populations were examined for seasonal changes in lipid content of muscle tissue, viscera and ovaries. Fish from Cherry Run exhibited seasonal lipid changes in muscle and viscera. Lipid changes were associated with reproductive output. Total lipids in all body components were higher in char from Fishing Creek. (Author's abstract)
W87-07521

PERSISTENCE AND STABILITY OF FISH AND INVERTEBRATE ASSEMBLAGES IN A REPEATEDLY DISTURBED SONORAN DESERT STREAM,
Savannah River Ecology Lab., Aiken, SC.
G. K. Meffe, and W. L. Minckley.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 177-191, January 1987. 3 fig, 7 tab, 43 ref. DOE Contract DE-AC09-76SR00-819.

Descriptors: *Limnology, *Invertebrates, *Floods, *Streams, *Fish populations, *Population dynamics, Aquatic populations, Stability analysis, Sonoran Desert, Aquatic animals, Benthic fauna, Fish, Populations.

Persistence, a measure of presence or absence of species, and stability, an estimate of assemblage equilibrium measured as constancy in species ranks or densities, should be considered when assessing temporal change in natural assemblages. Persistence and stability were measured in two distinct animal assemblages frequently disturbed by natural and severe flooding events, the fishes and benthic invertebrates in a Sonoran Desert stream. A persistence index (derived from colonization/extinction analyses) indicates high persistence of fishes for several decades, while benthic invertebrates were persistent except in periods of severe flooding. Stability of taxon rankings (measured by Kendall's W) was high for both assemblages, even though absolute population sizes fluctuated. Fish populations resisted even the most severe flood disturbances, whereas benthic invertebrates were decimated by particularly frequent and intensive flooding. The latter were resilient, however, and quickly recovered due to life history characteristics favoring rapid postflood recolonization. Although absolute numbers of organisms varied through orders of magnitude, more general aspects of assemblage structure (species' presence of absence, and relative rankings) remained relatively constant despite repeated and potentially devastating natural perturbations. (Author's abstract)
W87-07522

ALGAL COMMUNITY DYNAMICS IN TWO STREAMS ASSOCIATED WITH DIFFERENT GEOLOGICAL REGIONS IN THE SOUTHEASTERN UNITED STATES,
Alabama Univ., University. Dept. of Biology.
J. A. Lay, and A. K. Ward.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 305-324, January 1987. 6 fig, 7 tab, 67 ref. NSF Grant DEB-8112455.

Descriptors: *Limnology, *Algae, *Streams, *Plant populations, *Nutrients, *Primary productivity, Limestone, Sandstone, Populations, Productivity, Nitrates, Alkalinity, Organic carbon, Biomass, Diatoms, Alabama.

Two streams in Alabama with similar physical characteristics but located in different geological regions (limestone vs sandstone) were compared in terms of nutrient content, net primary productivity, and algal species composition. Significant differences were found in concentrations of nitrate, alkalinity, dissolved organic carbon and epilithic algal biomass between the two streams. Despite nutrient differences, annual net primary productivities for the two streams were similar, although there was a general trend for higher values in the limestone stream. Both streams were diatom dominated throughout most of the year, but species overlap was low. Gomphonema clevii, Achnanthes minutissima and Stigeoclonium sp. were dominant in the limestone stream and Eunotia spp. were dominant in the sandstone stream. Rates of net primary production were high when compared to other streams in the southeast but relatively low when compared to streams in other geographical regions. (Author's abstract)
W87-07523

ECOLOGY OF THE FRESHWATER MUSSEL HYDRIDELLA MENZIESI (GRAY) IN A SMALL OLIGOTROPHIC LAKE,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
M. R. James.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 337-348, January 1987. 3 fig, 3 tab, 36 ref.

Descriptors: *Limnology, *Oligotrophic lakes, *Mussels, *Ecology, *Mollusks, Lakes, Lake Rotokawau, New Zealand, Littoral zone, Zones, Aquatic animals, Energy sources, Primary productivity, Populations, Animal populations, Population density, Carbon, Nitrogen, Organic matter, Nitrogen cycle.

The standing stock and ecology of the freshwater mussel Hydridella menziesi was studied in Lake Rotokawau, a deep oligotrophic lake in New Zealand. The average mussel density was 160/sq m in the littoral zone and reached a maximum of 814/sq m. Allochthonous material was shown to be the major energy source with primary production in the lake able to provide less than 5% of the mussel population's carbon requirements. Particulate removal and ammonia-nitrogen generation rates were also measured to clarify the mussel's role in the cycling of organic material and nitrogen. (Author's abstract)
W87-07525

NICHE SPECIFICITIES OF FOUR FISH SPECIES (HOMALOPTERIDAE, COBITIDAE AND GOBIIDAE) IN A HONG KONG FOREST STREAM,
Hong Kong Univ. Dept. of Zoology.
D. Dudgeon.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 349-364, January 1987. 6 tab, 56 ref.

Descriptors: *Fish populations, *Limnology, *Fish food organisms, *Niches, *Streams, Ecology, Hong Kong, Tai Po Kau Forest Stream, Benthic fauna, Aquatic animals, Riffles, Reach, Fish food, Algae, Detritus, Insects, Diets, Sediments.

An investigation of niche separation by four benthic fish species from a riffle reach of Tai Po Kau Forest Stream, Hong Kong, concentrated on the expectation that the niches of sympatric fishes would separate along the microhabitat and/or food resource dimensions. Two feeding guilds were apparent; the homalopterids Pseudogastromyzon myersi and Liniparhomaloptera dispar consumed periphytic algae and fine detritus, while Tukugobius wui (Gobiidae) and Noemacheilus fasciolatus (Cobitidae) preyed on immature insects. T. wui and N. fasciolatus consumed a total of 38 taxa but only a small proportion of these comprised a major part of the diet of both species. Chironomid (Diptera) larvae and baetid (Ephemeroptera) nymphs were dominant dietary items and it is suggested that T. wui and N. fasciolatus feed predominantly on drifting insects. In addition to marked dietary similarity, both species exhibited high niche overlaps with respect to microhabitat, the homalopterids preferring habitat patches in the center of the stream, T. wui and N. fasciolatus occupying both bankside and intermediate (transitional between midstream and bankside) microhabitats. Laborato-

ry studies of sediment choices largely confirmed the generalization that species pairs with dietary overlaps had similar substrate preferences. In view of the observation that fishes with similar diets utilized similar microhabitats, it is unlikely that competition has been an important agent structuring the fish assemblage of Tai Po Kau Forest Stream. (Author's abstract)
W87-07526

SEDIMENTS OF LAKE BALDEGG (SWITZERLAND) - SEDIMENTARY ENVIRONMENT AND DEVELOPMENT OF EUTROPHICATION FOR THE LAST 100 YEARS (DIE SEDIMENTE DES BALDEGGERSEES (SCHWEIZ) - ABLAGERUNGSRAUM UND EUTROPHIERUNGSENTWICKLUNG WAHREND DER LETZTEN 100 JAHRE),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geologisches Inst.
F. Niessen, and M. Sturm.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 365-383, January 1987. 10 fig, 1 tab, 31 ref.

Descriptors: *Lake sediments, *Sediments, *Eutrophication, *Eutrophic lakes, Lake Baldegg, Switzerland, Lakes, Calcite, History, Fertilization, Carbon, Phosphorus, Algae, Diatoms.

The sedimentary environment of Lake Baldegg was studied in 55 gravity cores (each approximately 1 meter long). The sediments are dominated by endogenic calcite precipitation. Allochthonous influx is small. The distribution of rhythmically laminated sediments allowed a reconstruction of the 100 year eutrophication trend history. The progressive fertilization has left an imprint on mean calcite crystal size (enlargement from 5 to 30 microns) and on the phosphorus and carbon content (increase from 2 to 4% C and from 500 to 1000 micrograms/gram P) in the sediments. Previous results of studies on algal pigments and diatom shells in Lake Baldegg sediments by Zullig indicating two sudden shifts in algae communities since 1890 are discussed. (Author's abstract)
W87-07527

MICROBIAL ACTIVITY IN THE SURFICIAL SEDIMENTS OF AN OLIGOTROPHIC AND EUTROPHIC LAKE, WITH PARTICULAR REFERENCE TO DISSIMILATORY NITRATE REDUCTION,
Montana State Univ., Bozeman. Dept. of Biology.
J. C. Priscu, and M. T. Downes.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 385-409, January 1987. 8 fig, 3 tab, 41 ref.

Descriptors: *Limnology, *Lake sediments, *Sediments, *Microbiological studies, *Nitrates, *Oligotrophic lakes, *Eutrophic lakes, Lakes, Methanogenesis, Lake Taupo, New Zealand, Lake Rotongaio, Chlorophyll, Enzymes, Denitrification.

Samples were collected between August and October 1982 from Lake Taupo, an oligotrophic lake in New Zealand, and from Lake Rotongaio, a eutrophic explosion crater lake separated by a narrow ridge from Lake Taupo into which it flows via a short channel. The surficial sediments showed marked differences in the rates of microbial processes. Methanogenesis was the only process not present in the oligotrophic sediments with respect to those found in both lakes. These differences were related to the amount of chlorophyll that had apparently settled out of the water column. Chlorate inhibition studies showed that potential dissimilatory nitrate reductase (DNR) activity was about 80% of total potential nitrate reductase activity in both sediments. DNR was inducible only in the eutrophic sediments as shown by both in vitro DNR assays and N2O production in the presence of acetylene. NO3(-) enrichment (714 micromoles/liter) of the oligotrophic sediments increased Eh to the point where DNR was inactivated. The denitrification rate of intact sediments was less that 1% of the potential rate measured in continuously agitated sediment slurries, indicating that methods which include severe alteration of physical parameters will lead to overestimates of denitrification rate. Low recovery efficiencies of NO3(-)-N as NO2-N under effective acetylene blockage suggested that about 40-50% of the NO3(-) was dissimilated to NH4(+). This apparent dissimilatory reduction of NO3(-) to NH4(+) was relatively more important at high carbon/NO3(-) ratios implying that the extra electrons accommodated by this process may allow it to predominate over denitrification in reducing environments. (Wood-PTT)
W87-07528

SINKING RATES AND PHYSICAL PROPERTIES OF FAECAL PELLETS OF FRESHWATER INVERTEBRATES OF THE GENERA SIMULIUM AND GAMMARUS,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2J.
W87-07529

AMMONIUM THRESHOLDS FOR SIMULTANEOUS UPTAKE OF AMMONIUM AND NITRATE BY OYSTER-POND ALGAE,
Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
S. Y. Maestrini, J.-M. Robert, J. W. Leftley, and Y. Collos.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 102, No. 1, p 75-98, November 1986. 12 fig, 5 tab, 64 ref. CNEXO Grants 80/2248 and 80/2278, PIR-OCEAN Grant 257.

Descriptors: *Limnology, *Ammonium, *Bioaccumulation, *Nitrates, *Algae, *Nutrients, *Plant physiology, *Estuarine environment, Accumulation, Oysters, Mollusks, Ions, Ureas, Enzymes, Environment, Diatoms, Ammonium compounds, Nitrogen compounds, Ecology, Phytoplankton, Aquatic plants, Plankton.

Natural microalgal populations and axenic algal isolates from oyster ponds were grown either in situ or in controlled conditions in the presence of ammonium and nitrate as nitrogen sources. Nitrate uptake was found to be prevented by ammonium above a concentration which varied according to species. The ammonium threshold was 30 micromole N/L for natural populations and 21-44 for cultured strains. Nitrate uptake started at 39% of the eventual maximum rate observed for the natural populations, and from 11% to 17% for cultured strains. The initial low rate was maintained until ambient ammonium concentration had decreased to 7.5 micromole N/L and then operated at a slightly higher rate than the one for ammonium. Cultures with an initial ammonium concentration lower than the threshold values did not show an initial low rate or a lag phase for nitrate uptake. Urea was not taken up preferentially in the presence of nitrate. Its uptake was initially at a reduced rate until external nitrate concentration decreased to 3.7 micromole N/L and then increased to a maximum. The evolutionary and ecological significance of these results are discussed. (Author's abstract)
W87-07551

BIOLOGICAL HALF-LIFE, ORGAN DISTRIBUTION AND EXCRETION OF 125I-LABELLED TOXIC PEPTIDE FROM THE BLUE-GREEN ALGA MICROCYSTIS AERUGINOSA,
New England Univ., Armidale (Australia). Dept. of Biochemistry, Microbiology and Nutrition.
For primary bibliographic entry see Field 5B.
W87-07567

FACTORS IN HABITAT PREFERENCE IN SITU OF SULFUR-TURFS GROWING IN HOT SPRINGS EFFLUENTS: DISSOLVED OXYGEN AND CURRENT VELOCITIES,
Iwate Medical Univ., Morioka (Japan). Dept. of Biology.
Y. Maki.
Journal of General and Applied Microbiology JGAMA9, Vol. 32, No. 3, p 203-213, 1986. 5 fig, 2 tab, 16 ref. Keiryokai Research Foundation Grant 11.

Descriptors: *Physiological ecology, *Limnology, *Microbiological studies, *Hot springs, *Dissolved oxygen, *Water currents, *Sulfur bacteria, *Ecological distribution, *Aquatic habitats, Springs, Oxygen, Temperature, Water temperature, Acidity, Sulfides, Chemical properties, Physical properties, Bacteria, Streams, Pools, Habitats.

Field surveys of hot springs were carried out at four spas in Japan. Observations were made on the temperature, pH, dissolved oxygen and sulfide concentrations, current velocities, and the habitats of three types (A, B, C) of sulfur-turfs. The B-type (rods) was not present, while the A-type (sausage-shaped bacteria) grew only in the streams. In contrast, the C-type (filamentous bacteria) inhabited only the pools of hot spring water. Ranges of dissolved oxygen concentrations in situ were 6 to 31 microM for the A-type and 6 to 110 microM for the C-type sulfur-turfs. The sausage-shaped bacteria had peritrichous flagella which were not present in the filamentous C-type bacteria. It was suggested that the A-type sulfur-turf preferred the stream to the pool because of this bacteria's low level and narrow range of oxygen requirement and its ability to form aggregates by intertwining flagella, even in flowing water. In contrast, the C-type preferred the pool rather than the stream due to its wide range of oxygen requirements and its inability to form colonies in rapidly flowing water. (Author's abstract)
W87-07570

SEASONAL SUCCESSION AND VERTICAL DISTRIBUTION OF PHYTOPLANKTON IN CANDLEWOOD LAKE, CT,
New Hampshire Univ., Durham. Dept. of Botany.
S. J. Freeda, and P. A. Siver.
Rhodora RHODAB, Vol. 88, No. 855, p 331-346, July 1986. 5 fig, 1 tab, 16 ref.

Descriptors: *Limnology, *Succession, *Phytoplankton, *Seasonal distribution, *Vertical distribution, *Candlewood Lake, Connecticut, *Eutrophication, Trophic level, Lakes, Distribution, Planning, Management planning, Plankton, Populations, Aquatic populations, Plant populations, Nitrates, Phosphorus, Chlorophyll, Temperature, Water temperature, Conductivity, Oxygen, Dissolved oxygen, Light intensity, Physical properties, Chemical properties, Algae, Cyanophyta, Diatoms.

Prior to development of a management plan for Candlewood Lake (Fairfield and Litchfield Counties, CT), phytoplankton populations were recorded at several sites from April 1983 through January 1984. Vertical phytoplankton profiles were identified and counted to derive seasonal succession patterns and population concentrations. Vertical profiles of nitrate, phosphorus, chlorophyll a, phaeophytin a, temperature, conductivity, dissolved oxygen, and light were also recorded. Distributions of phytoplankton were seasonal; approximately 10,000 cells/ml occurred in the epilimnion during summer stratification. The lake was dominated (89%) by blue-green algae (Oscillatoriaceae and Nostocaceae). Diatoms and green algae were important during spring and winter, respectively. Horizontal phytoplankton distributions throughout the lake were similar and correlated well with chlorophyll a concentrations. Nitrate concentrations were generally low (<0.3 mg NO3/l) to non-detectable during the summer. Total phosphorus was high, averaging 35 micrograms/l on the surface. It is concluded that Candlewood Lake is in an early eutrophic state. (Author's abstract)
W87-07573

ISOLATION AND CHARACTERIZATION OF AEROBIC HETEROTROPHIC BACTERIA FROM NATURAL SPRING WATERS IN THE LANJARON AREA (SPAIN),
Universidad de Granada (Spain). Dept. of Microbiology.
J. Quevedo-Sarmiento, A. Ramos-Cormenzana, and J. Gonzalez-Lopez.
Journal of Applied Bacteriology JABAA4, Vol. 61, No. 4, p 365-372, October 1986. 1 fig, 3 tab, 25 ref.

Descriptors: *Limnology, *Bacterial analysis, *Aerobic bacteria, *Heterotrophic bacteria, *Lanjaron, Spain, *Mineral springs, *Species diversity, Water analysis, Bacteria, Springs, Pseudomonas, Flavobacterium, Aeromonas, Vibrio, Enteric bacteria, Alcaligenes, Aquatic bacteria, Chemical properties, Physical properties, Biological properties, Water properties.

Aerobic, heterotrophic bacteria were isolated from nine natural mineral water springs in the Lanjaron area of Spain between July 1980 and May 1981. The mineral waters contained few bacteria (mean counts 26-5,275 cfu/100 ml) and the bacterial flora of all nine springs was very similar. Most of the isolates (90%) were Gram-negative rods, and among these Pseudomonas spp. and members of the Flavobacterium-Cytophaga-Flexibacter group were numerically dominant. Aeromonas-Vibrio and Enterobacteriaceae isolates were an important fraction of the total number, but isolates from remaining groups (Acinetobacter, Chromobacterium, Alcaligenes, and Gram-positive organisms) constituted only a small proportion of the flora. The comparatively small number of species isolated and the occurrence of no more than three or four different bacterial types in spring water of different chemical and physical composition is discussed. (Author's abstract)
W87-07576

ZINC, COPPER AND NICKEL CONCENTRATIONS IN RYEGRASS GROWN ON SEWAGE SLUDGE-CONTAMINATED SOILS OF DIFFERENT PH,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 5E.
W87-07581

NEUTRALIZATION OF ACIDIC BROOKWATER USING A SHELL-SAND FILTER OR SEA-WATER: EFFECTS ON EGGS, ALEVINS AND SMOLTS OF SALMONIDS,
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
For primary bibliographic entry see Field 5G.
W87-07593

2I. Water In Plants

HYPOTHESIZED RESOURCE RELATIONSHIPS AMONG AFRICAN PLANKTONIC DIATOMS,
Michigan Univ., Ann Arbor. Dept. of Biological Chemistry.
For primary bibliographic entry see Field 2H.
W87-06672

COMPARISON OF METHODS FOR MEASURING PRODUCTION BY THE SUBMERSED MACROPHYTE, POTAMOGETON PERFOLIATUS L.,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2H.
W87-06681

SIMULATED RELATIONSHIPS BETWEEN SPECTRAL REFLECTANCE, THERMAL EMISSIONS, AND EVAPOTRANSPIRATION OF A SOYBEAN CANOPY,
San Diego State Univ., CA. Dept. of Geography.
For primary bibliographic entry see Field 2D.
W87-06693

CORN AND WHEAT RESPONSE TO TOPSOIL THICKNESS AND PHOSPHORUS ON RECLAIMED LAND,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
G. A. Halvorson, A. Bauer, S. A. Schroeder, and S. W. Melsted.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 73-76, January-March 1987. 1 fig, 6 tab, 17 ref.

Descriptors: *Coal mining, *Land reclamation, *Topsoil, *Phosphorus, *Corn, *Wheat, Agriculture, Crop yield, Soil water, Fertilizers, Nutrients, Silage, Soil types, Growth.

Stripmining of coal drastically disturbs agricultural land and may alter many of the plant-soil-water relationships of undisturbed land. Plots were established on leveled moderately sodic clay loam mine spoil to evaluate topsoil thickness and P on crop production and soil moisture in a semiarid environment. A nonsodic sandy loam topsoil was replaced on the spoil at thicknesses of 0.05, 0.15, 0.30, and 0.60 m. Prior to topsoil placement, P was broadcast on the leveled spoil at rates of 0, 34, and 100 kg P/ha. Phosphorus at rates of 0, 11, and 34 kg/ha was applied annually for 4 yr to plots seeded to hard red spring wheat (Triticum aestivum L.) using a drill attachment and by banding to corn (Zea mays L.). In the last 2 yr, P broadcast rates of 0, 12, and 12 kg P/ha on wheat and 0, 18, and 18 kg P/ha on corn were substituted for the drilled and banded P treatments. Corn silage and wheat grain yields in most years were significantly higher on 0.15-, 0.30-, and 0.60-m topsoil compared to 0.05 m. The clay loam spoil was not as drought prone as the sandy loam topsoil and therefore, as the thickness of topsoil increased, the ability of the profile to continuously supply water to the growing crop decreased. The relationship between wheat yield and total water use was similar to undisturbed soils in the Northern Great Plains. Responses of wheat and corn to the one time broadcast application of P to the topsoil-spoil interface or annual applications were generally small and occurred at the low rate of P. (Author's abstract)
W87-06727

EXCHANGE RATES OF O2 AND CO2 BETWEEN AN ALGAL CULTURE AND ATMOSPHERE,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
For primary bibliographic entry see Field 2H.
W87-06751

INFLUENCE OF SPATIALLY VARIABLE SOIL HYDRAULIC PROPERTIES ON PREDICTIONS OF WATER STRESS,
Missouri Univ.-Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W87-06793

EFFECT OF GROWTH RATE ON THE GROWTH OF BACTERIA IN FRESHLY MOISTENED SOIL,
Georgia Univ., Athens. Dept. of Agronomy.
P. G. Hartel, and M. Alexander.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 93-96, January-February 1987. 2 fig, 3 tab, 21 ref.

Descriptors: *Growth rates, *Bacterial growth, *Soil solutions, *Wet soil, Silt, Loam, Growth, Bacteria, Prediction, Incubation, Nutrients, Indicators.

A study was conducted to determine the significance of growth rate on the ability of six bacterial strains to grow in soil immediately following moistening of air-dry soil and to determine if growth in soil solution could be used as a predictor of bacterial growth in soil. The generation times of the six bacterial strains in soil solution extracted from unincubated Eel silt loam ranged from 0.53 to 8.45 h. The six bacteria grew in Eel silt loam that was air-dried and moistened immediately before inoculation, and the extent of growth was directly correlated with the rate of growth of the bacteria, except for one species. The six bacteria did not increase in number in Eel silt loam that had been previously incubated for 14 d after moistening. However, addition of glutamate to this soil increased the numbers of the bacteria that grew most rapidly and had essentially no influence on the two slowest growing strains. Similar results were obtained with strains of Pseudomonas and Bradyrhizobium in two other soils or soil solutions obtained from them. The data indicate that growth in soil solution was a good indicator of the ability of bacteria to grow in nonsterile soil when the soil was inoculated immediately following moistening of air-dry soil and that slow growth, the absence of available C, or both, limit bacterial proliferation. (Author's abstract)
W87-06804

DIVERSITY OF EUCALYPTUS SPECIES PREDICTED BY A MULTI-VARIABLE ENVIRONMENTAL GRADIENT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
C. R. Margules, A. O. Nicholls, and M. P. Austin.
Oecologia OECOBX, Vol. 71, No. 2, p 229-232, January 1987. 2 fig, 1 tab, 15 ref.

Descriptors: *Environmental gradient, *Species diversity, *Model studies, *Annual rainfall, *Temperature effects, *Solar radiation, *Eucalyptus, Statistical analysis, Rainfall, Temperature, Australia.

Changes in species diversity were examined in relation to a multidimensional environmental gradient using Eucalyptus species in south-eastern Australia. By fitting a generalized linear model, the response of the community parameter, species diversity, was shown to be related to three environmental variables, mean annual rainfall, mean annual temperature and a relative measure of solar radiation. The effects of rainfall and temperature were both statistically significant and large, solar radiation was significant but small. However, the influence of the two major variables was not independent but interacted in a complex way that prevents adequate description of species diversity as a function of either variable alone. Possible biological explanations of the complexity are discussed in terms of limiting conditions at low temperatures, and competition between guilds of species at high temperatures and medium to high rainfall. (Author's abstract)
W87-06841

FIELD PHOTOSYNTHESIS, MICROCLIMATE AND WATER RELATIONS OF AN EXOTIC TEMPERATE LIANA, PUERARIA LOBATA, KUDZU,
Maryland Univ., College Park. Dept. of Botany.
I. N. Forseth, and A. H. Teramura.
Oecologia OECOBX, Vol. 71, No. 2, p 262-267, January 1987. 6 fig, 1 tab, 30 ref.

Descriptors: *Leaves, *Water potentials, *Kudzu, *Photosynthesis, *Lianas, *Microclimates, Stomatal conductance, Humidity, Temperature, Light intensity, Plants, Growth, Shade, Transpiration.

Kudzu occurs in a variety of habitats in the southeastern United States. Microclimate, stomatal conductance, leaf water potential and photosynthetic responses to light, temperature and humidity were measured in two contrasting microhabitats on Pueraria lobata, kudzu. Midsummer leaf temperatures and leaf-to-air water vapor deficits for plants growing in an exposed site were significantly greater than for those in a shaded site, exceeding 35 C and 50 mmol/mol, respectively. Maximum stomatal conductance exceeded 400 mmol/sq m/s in exposed leaves during peak vegetative growth. Stomatal conductance in shaded leaves was approximately half the value measured in exposed leaves on any particular day. Maximum photosynthetic carbon uptake was also higher in leaves growing in exposed sites compared to leaves in shaded sites, exceeding 18.7 and 14.0 micromol/sq m/s, respectively. Photosynthesis, stomatal conductance and intercellular CO2 concentration decreased dramatically in response to increasing water vapor deficit for leaves from both sites. However, transpiration showed an initial increase at intermediate water vapor deficits, leveling off or even decreasing as higher values. Leaf water potential demonstrated marked diurnal variation, but remained constant over a wide range of transpirational water fluxes. This latter feature, combined with microenvironmental modification through

rapid leaf orientation and pronounced stomatal responses to water vapor deficits may represent important adaptive responses in the exploitation of a diverse array of habitats by kudzu. (Author's abstract)
W87-06842

RELATIONSHIPS OF SALT-MARSH PLANT DISTRIBUTIONS TO TIDAL LEVELS IN CONNECTICUT, USA,
Connecticut Univ., Storrs. Ecology Section.
For primary bibliographic entry see Field 2L.
W87-07085

CORN YIELD AND WATER USE AS INFLUENCED BY IRRIGATION LEVEL, N RATE, AND PLANT POPULATION DENSITY,
Kansas State Univ., Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W87-07090

METABOLIC CHANGES ASSOCIATED WITH ADAPTATION OF PLANT CELLS TO WATER STRESS,
Purdue Univ., Lafayette, IN. Dept. of Horticulture.
D. Rhodes, S. Handa, and R. A. Bressan.
Plant Physiology PLPHAY, Vol. 82, No. 4, p 890-903, December 1986. 7 fig, 8 tab, 39 ref.

Descriptors: *Adaptation, *Water stress, *Plant physiology, *Osmotic pressure, Amino acids, Proline, Nitrogen isotopes, Nitrogen, Kinetics, Membrane processes, Tomatoes, Computers, Simulation.

Suspension cultured cells of tomato (Lycopersicon esculentum Mill. cv VENT Cherry) adapted to water stress induced with polyethylene glycol 6000 (PEG) exhibit marked alterations in free amino acid pools. Using computer simulation models the in vivo rates of synthesis and utilization and compartmentation of free amino acid pools were determined from 15N labelling kinetics. The 300-fold elevated proline pool in 25%-PEG adapted cells is primarily the consequence of a 10-fold elevated rate of proline synthesis (glutamate pathway). The calculations suggest that the rate of proline synthesis only slightly exceeds that necessary to sustain both protein synthesis and proline pool maintenance with growth. Mechanisms must operate to restrict proline oxidation in adapted cells. Glutamine depletion appears to result from selective depletion of a large, metabolically inactive storage pool present in unadapted cultures. The labelling kinetics of the amino nitrogen groups of glutamine and glutamate are consistent with operation of the glutamine synthetase-glutamate synthase cycle in both cell lines. However, we could not conclusively descriminate between exclusive operation of the GS-GOGAT cycle and a 10-20% contribution of the glutamate dehydrogenase pathway of ammonia assimilation. Adaptation effects on synthesis and utilization of other amino acids are also discussed. Tentative models of the nitrogen flux of these two contrasting cell lines are discussed in relation to carbon metabolism, osmoregulation, and nitrogenous solute compartmentation. (Airone-PTT)
W87-07131

EFFECT OF OSMOTIC STRESS ON ION TRANSPORT PROCESSES AND PHOSPHOLIPID COMPOSITION OF WHEAT (TRITICUM AESTIVUM L.) MITOCHONDRIA,
Agricultural Research Service, Lubbock, TX. Plant Stress and Water Conservation Research Unit.
R. R. Klein, J. J. Burke, and R. F. Wilson.
Plant Physiology PLPHAY, Vol. 82, No. 4, p 936-941, December 1986. 3 fig, 3 tab, 32 ref.

Descriptors: *Water stress, *Osmotic pressure, *Plant physiology, *Mitochondria, *Ion transport, *Wheat, Membrane processes, Roots, Leaves.

The effect of osmotic stress on wheat mitochondrial activity and phospholipid composition was investigated. Preliminary growth measurements showed that osmotic stress (-0.25 or -0.5 MPa external water potential) inhibited the rate of shoot dry matter accumulation while root dry matter accumulation was less sensitive. We have determined that differences in sensitivity to osmotic stress exist between tissues at the mitochondrial level. Mitochondria isolated from roots or shoots of stressed seedlings showed respiratory control and ADP/O ratios similar to control seedlings which indicates that stressed mitochondria are well coupled. However under passive swelling conditions in KCl mixture, the rate and extent of valinomycin-induced swelling of shoot mitochondria were increased by osmotic stress while root mitochondria were largely unaffected. Active ion transport studies showed efflux transport by stressed-shoot mitochondria to be partially inhibited since mitochondrial contraction required the addition of N-ethylmaleimide or nigericin. Efflux ion transport by root mitochondria was not inhibited by osmotic stress. Characterization of mitochondrial fatty acid and phospholipid composition showed an increase in the percentage of phosphatidylcholine in stressed shoot mitochondria compared to the control. Mitochondrial fatty acid composition was not markedly altered by stress. No significant changes in either phospholipid or fatty acid composition of stressed root mitochondria were observed. The results suggest that a tissue-specific response to osmotic stress exists at the mitochondrial level. (Author's abstract)
W87-07132

EFFECTS OF NACL AND CACL2 ON CELL ENLARGEMENT AND CELL PRODUCTION IN COTTON ROOTS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
E. Kurth, G. R. Cramer, A. Lauchli, and E. Epstein.
Plant Physiology PLPHAY, Vol. 82, No. 4, p 1102-1106, December 1986. 6 fig, 1 tab, 36 ref. NSF Grant DMB84-04442.

Descriptors: *Osmotic pressure, *Saline water, *Plant physiology, *Calcium, *Cotton, Roots, Water stress, Membrane processes.

In many crop species, supplemental Ca(2+) alleviates the inhibition of growth typical of exposure to salt stress. In hydroponically grown cotton seedlings (Gossypium hirsutum L. cv Acala SJ-2), both length and weight of the primary root were enhanced by moderate salinities (25 to 100 millimolar NaCl) in the presence of 10 millimolar Ca(2+), but the roots became thinner. Anatomical analysis showed that the cortical cells of these roots were longer and narrower than those of the control plants, while cortical cells of roots grown at the same salinities but in the presence of only 0.4 millimolar Ca(2+) became shorter and more nearly isodiametrical. Cell volume, however, was not affected by salinities up to 200 millimolar NaCl at either 0.4 or 10 millimolar Ca(2+). The observations suggest Ca(2+) dependent effects of salinity on the cytoskeleton. The rate of cell production declined with increasing salinity at 0.4 millimolar Ca(2+) but at 10 millimolar Ca(2+) was not affected by salinities up to 150 millimolar NaCl. (Author's abstract)
W87-07133

FIELD WATER RELATIONS OF A WET-TROPICAL FOREST TREE SPECIES, PENTACLETHRA MACROLOBA (MIMOSACEAE),
Duke Univ., Durham, NC. Dept. of Botany.
S. F. Oberbauer, B. R. Strain, and G. H. Riechers.
Oecologia OECOBX, Vol. 71, No. 3, p 369-374, February 1987. 5 fig, 3 tab, 36 ref. NSF Grants BSR 82-15533, BSR 82-14858 and DEB 80-21312.

Descriptors: *Stomatal transpiration, *Leaves, *Water potentials, Osmosis, Forests, Canopy, Turgor, Stomata, Seasonal variation, Understory, Plants, Costa Rica.

The water relations of Pentaclethra macroloba (Willd.) Kuntze, a dominant, shade-tolerant, tree species in the Atlantic lowlands of Costa Rica, were examined within the forest canopy. Pressure-volume curves and diurnal courses of stomatal conductance and leaf water potential were measured in order to assess differences in water relations between understory, mid-canopy and canopy leaves. Leaves in the canopy had the smallest pinnules but the largest stomatal frequencies and stomatal conductances of the three forest levels. Osmotic potentials at full turgidity decreased with height in the forest; in the canopy and mid-canopy they were reduced relative to those in the understory just enough to balance the gravitational component of water potential. Consequently, maximum turgor pressures were similar for leaves from all three canopy levels. Bulk tissue elastic modulus increased with height in the canopy. Leaf water potentials were lowest in the canopy and highest in the understory, even when the gravitational component was added to mid-canopy and canopy values. As a result, minimum turgor pressures were also lowest in the canopy compared to those at lesser heights, and approached zero in full sunlight on clear days. Osmotic potentials at each canopy level were similar for both wet and dry season samples dates suggesting that seasonal osmotic adjustment does not occur. Despite lowered predawn water potentials during the dry season, turgor was maintained in the understory by reduced stomatal conductances. (Author's abstract)
W87-07172

SODIUM RELATIONS IN SEEDS AND SEEDLINGS OF SARCOBATUS VERMICULATUS,
Oregon State Univ., Corvallis. Dept. of Rangeland Resources.
L. E. Eddleman, and J. T. Romo.
Soil Science SOSCAK, Vol. 143, No. 2, p 120-123, February 1987. 2 tab, 18 ref. DOE Contract EV-76-5-06-2232.

Descriptors: *Sodium, *Seedlings, *Greasewood, *Tissue analysis, *Osmotic potential, Salt tolerance, Shrubs, Sarcobatus, Salts, Accumulation.

Sodium content of utricles, utricle bracts, testa, and embryo was determined for Sarcobatus vermiculatus. Immediately after germination, seedlings were grown in H2O, 330 mM NaCl, or 225 mM Na2SO4 solutions, and Na(+) content was determined. Sodium content of utricles averaged 38900 microgram(ug)/g, with highest concentrations in bracts (53100 ug/g), and lowest concentrations (1843 ug/g) in embryos. Sodium concentration of washed embryos averaged 954 ug/g. Seedlings germinated from debracted utricles and grown 24 h in distilled H2O contained 2965 ug/g Na(+). The Na(+) content of seedlings germinated and grown 24 h in NaCl or Na2SO4 solutions averaged approximately 24000 ug/g. Rapid uptake of Na(+) by the germinating embryos and seedlings is postulated to be an adaptive mechanism for developing and maintaining a favorable water balance in soils with low osmotic potentials. (Author's abstract)
W87-07224

UTILIZATION OF GROWTH PARAMETERS OF EELGRASS, ZOSTERA MARINA, FOR PRODUCTIVITY ESTIMATION UNDER LABORATORY AND IN SITU CONDITIONS,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
S. P. Hamburg, and P. S. Homann.
Marine Biology MBIOAJ, Vol. 93, No. 2, p 299-303, November 1986. 2 fig, 1 tab, 29 ref.

Descriptors: *Eelgrass, *Allometry, *Net productivity, *Biomass, Plant growth, Light intensity, Roots, Shoots.

Allometry was used for monitoring aboveground growth of the marine angiosperm Zostera marina L. Dry weight was regressed with leaf length and width, allowing estimation of aboveground net productivity and biomass of individual plants. At the termination of the experiment, rhizome productivity of the same plants was determined by harvesting. Plants in shaded and unshaded seawater tanks were monitored from June until September, 1976: in situ plants were also monitored at Point Judith Pond, Rhode Island, USA. Unshaded plants had shorter leaves, a lower net productivity, lower biomass, and a lower aboveground-to-rhizome pro-

ductivity ratio than shaded plants. Unshaded plants had a higher rate of rhizome branching and the resulting new shoot formation than in situ plants. (Author's abstract)
W87-07228

ROLE OF LEAF POSITION IN THE ECOPHYSIOLOGY OF AN ANNUAL GRASS DURING REPRODUCTIVE GROWTH,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
L. E. Jackson, J. L. J. Houpis, and M. W. Diemer.
The American Midland Naturalist AMNAAF, Vol. 117, No. 1, p 56-62, January 1987. 3 fig, 2 tab, 24 ref.

Descriptors: *Isotope studies, *Grasses, *Soil water, *Soil-water-plant relationships, *Leaves, *Plant tissues, Plant physiology, Stomata, California, Grasslands, Stomatal transpiration, Field tests, Conductance, Photosynthesis, Chlorophyll a, Carotenoids, Moisture deficiency, Droughts, Nitrogen.

In Bromus mollis, a widespread annual grass in the summer-dry California grasslands, leaf senescence occurs during inflorescence development. Under field conditions in April, as soil began to dry, midday conductances and C14 photosynthesis were highest in leaves near the apex of the plant, but lower older leaves maintained more positive leaf water potential (psi sub leaf). Chlorophyll a, a/b ratio and carotenoid content were also greater in higher leaves. Over half of the C14 labeled in midmorning accumulated in the inflorescences by evening. A controlled experiment showed that soil drought results in midday stomatal closure and lower psi sub leaf, lower nitrogen content and less effect of leaf position on these parameters. In the B. mollis, regulation of nitrogen and chlorophyll content in relation to leaf position may be ways of increasing carbon assimilation once self-shading has begun and soil moisture deficits are imminent. (Author's abstract)
W87-07517

SALT TOLERANCE IN THE TRITICEAE: SOLUTE ACCUMULATION AND DISTRIBUTION IN AN AMPHIDIPLOID DERIVED FROM TRITICUM AESTIVUM CV. CHINESE SPRING AND THINOPYRUM BESSARABICUM,
University Coll. of North Wales, Bangor. Dept. of Biochemistry and Soil Science.
J. Gorham, B. P. Forster, E. Budrewicz, R. G. Wyn Jones, and T. E. Miller.
Journal of Experimental Botany, Vol. 37, No. 183, p 1435-1449, October 1986. 3 fig, 7 tab, 19 ref.

Descriptors: *Salt tolerance, *Triticum, *Thinopyrum, *Plant physiology, *Distribution, *Bioaccumulation, *Solute transport, Grain crops, Wheat, Agronomy, Accumulation, Chlorides, Sodium, Leaves.

A number of perennial, salt-tolerant species of Triticeae have been hybridized with wheat and the resulting progeny tested for salt tolerance. An amphidiploid derived by colchicine treatment of a hybrid between Triticum aestivum cv. Chinese Spring and Thinopyrum bessarabicum was found to be more salt tolerant than the wheat cultivars Chinese Spring, Kharchia, and Ciano 79 in terms of survival and grain yield at 250 mol/cu m NaCl. Tolerance was related to the ability of the amphidiploid to exclude Na and Cl from the shoots, and particularly from the young leaves, developing inflorescence, and grain. No relationship was found between the salt tolerance of the different species and varieties tested and changes in the concentrations of other solutes. The amphidiploid did not inherit the high glycinebetaine concentrations characteristic of the wheatgrass parent. It is concluded that amphidiploids produced from crosses between Thinopyrum species and wheat may be useful as stress-resistant new crops. (Author's abstract)
W87-07556

CHEMICAL AND HYDRAULIC INFLUENCES ON THE STOMATA OF FLOODED PLANTS,
Lancaster Univ., Bailrigg (England). Dept. of Biological Sciences.
J. Zhang, and W. J. Davies.
Journal of Experimental Botany, Vol. 37, No. 183, p 1479-1491, October 1986. 9 fig, 1 tab, 38 ref.

Descriptors: *Plant physiology, *Stomata, *Flooding, *Soil-water-plant relationships, *Peas, *Potassium, Leaves, Water potentials, Seedlings, Turgidity, Accumulation, Solute transport, Growth.

Stomatal behavior and leaf growth of pea plants (Pisum sativum) were studied in response to inundation of the soil by fresh water. Pea seedlings were grown for two weeks in the greenhouse at 25 C, the pots watered daily to the drip point. At the four-leaf stage, half the plants were flooded. Stomatal conductance was measured with a diffusion porometer, and leaf water potential was measured continuously with psychrometers. Additional experiments were conducted using an incubation technique. It was found that flooding greatly reduced stomatal opening and leaf growth rate, despite the fact that leaf water potential and turgor were not significantly affected by the treatment. Potassium uptake and transport to the leaves was reduced by flooding. Stomata of flooded plants could be reopened by incubating leaves in solutions containing KCl. These observations raise the possibility that nutrient deficiency may limit stomatal opening and growth in flooded plants. It is also possible that potassium deficiency may interact with a modification in the balance of growth regulators in the leaves to modify stomatal behavior and growth. (Author's abstract)
W87-07557

ACTIVITIES OF CARBOXYLATION ENZYMES IN FRESHWATER MACROPHYTES,
Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
A. M. Farmer, S. C. Maberly, and G. Bowes.
Journal of Experimental Botany, Vol. 37, No. 183, p 1568-1573, October 1986. 1 tab, 27 ref. USDA Grant 82-CRCR-1-1147.

Descriptors: *Enzymes, *Plant physiology, *Macrophytes, *Aquatic plants, *Metabolism, *Photosynthesis, *Submerged plants, Floating plants, Leaves, Biochemistry, Temperature effects.

Fifteen species of freshwater macrophytes, mainly from cool, temperate waters, were assayed for ribulose bisphosphate carboxylase-oxygenase (RuBPCase) and phosphoenolpyruvate carboxylase (PEPCase) activities. In extracts from all the species, RuBPCase was the most active carboxylation enzyme, and the RuBPCase/PEPCase ratio was at least 2.0, even for the submersed species Isoetes lacustris and Littorella uniflora, which have been reported to show Crassulacean Acid Metabolism (CAM) activity. The PEPCase activity in I. lacustris was lower than that found in some non-CAM-like species. In this respect, I. lacustris and L. uniflora differ from most terrestrial CAM plants. However, these two species, along with Potamogeton praelongus Wulf. and Juncus bulbosus var. fluitans L., had the lowest RuBPCase/PEPCase ratios, lower than found in terrestrial C3 species, suggesting that the potential for substantial photosynthetic metabolism of C4 acids exists in some temperate, submersed plants. In the three amphibious species examined (Potamogeton polygonifolius, Mentha aquatica, and Hippuris vulgaris), the aerial leaves exhibited higher RuBPCase activities than the submersed leaves. (Author's abstract)
W87-07558

EFFECTS OF FLOODING ON WATER RELATIONS AND GROWTH OF THEOBROMA CACAO VAR. CATONGO SEEDLINGS,
Wisconsin Univ.-Madison. Dept. of Forestry.
A. R. Sena Gomes, and T. T. Kozlowski.
Journal of Horticultural Science JASCA8, Vol. 61, No. 2, p 265-276, April 1986. 4 fig, 5 tab, 40 ref.

Descriptors: *Flooding, *Soil-water-plant relationships, *Theobroma, *Seedlings, *Agronomy, *Transpiration, Horticulture, Soil water, Plant physiology, Stomata, Leaves, Growth, Roots, Root development, Drought resistance.

Soil flooding induced stomatal closure and lowered the transpiration rate of Theobroma cacao var. catongo seedlings within two hours in growth chamber and greenhouse experiments. The early stomatal closure was not associated with leaf dehydration. Subsequent responses to flooding included inhibition of leaf formation and expansion, reduction in dry weight increment and in relative growth rates of leaves, stems, and roots (with root growth reduced most), height growth, and stem diameter growth. In addition, flooding was followed by leaf epinasty, extensive decay of roots, and formation of hypertrophied lenticels and adventitious roots on submerged stems. The effects of flooding differed quantitatively on dry weight increment and on the relative growth rates of leaves, stems, and roots. Flooding the soil in a controlled-environment chamber inhibited seedling growth more than flooding in a greenhouse. The greatly lowered root:shoot ratio of flooded seedlings indicated that drought tolerance of seedlings will be reduced after the flood waters recede because the absorption of water by the small root systems will be too low to meet transpiration requirements. Inhibition of vegetative growth by flooding will probably reduce the yield of T. cacao by prolonging the time to first flowering and by suppressing vegetative growth. (Author's abstract)
W87-07565

N2 FIXATION (C2H2-REDUCING ACTIVITY) AND LEGHAEMOGLOBIN CONTENT DURING NITRATE- AND WATER-STRESS-INDUCED SENESCENCE OF MEDICAGO SATIVA ROOT NODULES,
Navarra Univ., Pamplona (Spain). Dept. Fisiologia Vegetal.
M. Becana, P. Aparicio-Tejo, J. Pena, J. Aguirreolea, and M. Sanchez-Diaz.
Journal of Experimental Botany, Vol. 37, No. 178, p 597-605, May 1986. 4 fig, 30 ref. CAICYT (Spain) Grant 2455-83.

Descriptors: *Nitrogen fixation, *Plant physiology, *Water stress, *Medicago, *Roots, *Nitrates, Enzymes, Drought, Proteins, Legumes, Nitrogen cycle, Metabolism, Water potentials, Statistical analysis, Soil-water-plant relationships.

Nitrate and water stress were used to induce senescence in root nodules of alfalfa (Medicago sativa). Nodule senescence was assessed by determinations of the nitrogenase (C2H2-reducing) activity, and the leghemoglobin (LHb) and total soluble protein contents of the nodules. Nodules responded similarly to NO3(-) and water stress in many respects, although there was a significant difference. All parameters of nodule activity (expressed on the basis of nodule dry weight) consistently decreased following treatment with NO3(-) or during drought; there was a significant interaction (synergism) between the inhibitory effects of NO3(-) and water stress on nitrogenase activity, but such effects were merely additive in the case of LHb content or LHb/soluble protein ratio. However, NO3(-) caused the selective decay of LHb with respect to other nodular soluble proteins, whereas the decrease of LHb during water stress was due to a general inhibition of protein synthesis and to an increased proteolytic activity in the nodule cytosol rather than to a specific proteolysis of LHb. (Author's abstract)
W87-07566

MODELING EVAPOTRANSPIRATION FROM SAGEBRUSH-GRASS RANGELAND,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2D.
W87-07574

FIELD SCREENING TECHNIQUE FOR DROUGHT TOLERANCE,
Haryana Agricultural Univ., Hissar (India). Dept. of Plant Breeding.
P. Sagar, and R. L. Kapoor.
Experimental Agriculture EXAGAL, Vol. 22, No. 2, p 117-122, April 1986. 1 fig, 3 tab, 17 ref.

Descriptors: *Field tests, *Drought resistance, *Estimating, *Culturing techniques, *Plant physiology, *Soil-water-plant relationships, Stress, Irrigation, Wind, Monsoons, Water stress, Rainfall, Rainfall distribution, Rainfall intensity, Slopes, Runoff, Surface runoff, Crop production.

A simple but effective field screening technique was developed for estimating drought tolerance. The technique involves growing plants in sloping plots which are opposite each other and connected to sub-channels lined with polyethylene sheet. The slopes are designed to achieve instant surface runoff, and the sub-channels are connected to a main channel for rapid drainage of rainwater. Stress is created at different stages of crop growth by manipulating the timing of irrigation and covering the soil surface with polyethylene sheeting. The technique proved effective even in the monsoon season, which is characterized by irregular intensity and distribution of rainfall. Data on six characters for 80 genotypes of pearl millet grown in six artificially created environments representing different levels of moisture stress are discussed. The 'slope' technique was found to be effective in creating different levels of moisture stress at various stages of crop growth and in distinguishing categories of genotypes by their relative drought tolerance. The variation in mean effects on most of the attributes was similar in short-stress and prolonged-stress treatments, suggesting that two levels of water stress and a non-stressed control might be sufficient to detect differences in drought response in pearl millet. (Author's abstract)
W87-07579

2J. Erosion and Sedimentation

SOIL LOSS AND TIME TO EQUILIBRIUM FOR RILL AND CHANNEL EROSION,
British Columbia Univ., Vancouver. Dept. of Soil Science.
M. D. Novak.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1790-1793, November-December 1985. 1 fig, 1 tab, 11 ref.

Descriptors: *Erosion, *Soil loss, *Rill erosion, *Channel erosion, *Overland flow, *Runoff, Mathematical equations, Equations, Prediction, Equilibrium.

Simple physically-based equations that predict long-term soil losses by rill erosion are derived by assuming that the rills equilibrate with the maximum overland flow occurring in the period of interest. Predicted annual soil losses exceed generally accepted values by roughly an order of magnitude, showing that rills on cultivated soils are not in equilibrium with the surface runoff that led to their formation. It is shown how to calculate the time required to reach equilibrium. These times (5 to 500 y) show that the equations are applicable to relatively undisturbed areas in which rill and channel erosion occur. (Author's abstract)
W87-06639

SEDIMENT YIELD AND WATER QUALITY FROM A STEEP-SLOPE SURFACE MINE SPOIL,
Brown and Caldwell, Atlanta, GA.
P. S. Dickens, B. A. Tschantz, and R. A. Minear.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1838-1845, November-December 1985. 7 fig, 6 tab, 36 ref.

Descriptors: *Erosion, *Sediment yield, *Storm runoff, *Water quality, *Slopes, *Mine wastes, *Path of pollutants, New River Basin, Minerals, Sediments, Effluents, Runoff, Weathering.

Sediment yield and storm runoff water quality from a steep-slope, back-to-contour, coal surface mining spoil in the New River Basin of Tennessee were monitored for a period of three years. Sediment and mineral constituent concentrations observed in storm runoff from the spoil increased to a maximum 1.1 to 1.3 years following the completion of mining, then declined. This increase was associated with the loss of mulch provided at reclamation and the onset of rill and gully erosion. Maximum sediment yield also occurred within this period. By the end of the third year following mining, a dense and uniform vegetative cover had become established on the spoil. Sediment, iron, and manganese concentrations decreased to premining levels and met Federal mine effluent standards. Calcium and magnesium concentrations, however, remained elevated above premining levels indicating chemical weathering of the spoil surface continued after sediment production had subsided. The runoff studied is non-acid. (Author's abstract)
W87-06647

DETACHMENT AND SPLASH OF A COHESIVE SOIL BY RAINFALL,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
J. P. Schultz, A. R. Jarrett, and J. R. Hoover.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1878-1884, November-December 1985. 8 fig, 42 ref.

Descriptors: *Silt loam, *Erosion, *Soil erosion, *Rainfall, *Simulated rainfall, *Soil water, Rainfall impact, Ponding, Accumulation, Soil types, Shear stress, Strength.

Time dependent relationships between soil detachment and splash, soil shear strength and the depth of ponded water on the soil surface were developed for Hagerstown silt loam under simulated rainfall. Soil splash rate was highly correlated to soil shear strength and increased exponentially from 26 kg/ha-min at initial conditions to about 149 kg/ha-min as the shear strength of the soil surface decreased as the soil water content approached saturation. After this point, the increasing depth of water ponded on the soil surface decreased the amount of soil splash by cushioning the impact of the rainfall. The soil splash rate decreased from 149 kg/ha-min at the start of ponding to zero when about four millimeters of water had ponded on the soil surface. The rate of accumulation of detached soil particles from the surface decreased with time and the depth of water ponded on the soil surface. This mass of suspended soil on the surface after 5 min was approximately ten times the mass of soil found in raindrop splash (2350 kg/ha vs. 171 kg/ha). (Author's abstract)
W87-06654

EROSION AND PRODUCTIVITY INTERRELATIONS ON A SOIL LANDSCAPE,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
C. A. Onstad, F. J. Pierce, R. H. Dowdy, and W. E. Larson.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1885-1888, November-December 1985. 3 fig, 4 tab, 7 ref.

Descriptors: *Erosion, *Soil erosion, *Productivity, *Soil landscapes, *Rainfall, *Soil mapping, Catenas, Soil physical properties, Sediment transport, Minnesota.

A soil landscape catena was selected in southeastern Minnesota comprising five soil mapping units. One hundred years of rainfall were generated and used as input to estimate erosion and deposition at various points along the soil landscape. Productivity of isolated soil mapping units decreased with increased erosion, as expected. When each soil was placed in its proper position in the soil landscape, its productivity index changed as a function of its position in addition to its soil physical characteristics related to erosion and sediment transport. The analysis illustrates that changes in productivity indexes on soil mapping units can give misleading information unless they are considered in their proper positions on a soil landscape. (Author's abstract)
W87-06655

NORTHWEST RANGELAND SEDIMENT YIELD ANALYSIS BY THE MUSLE,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. W. Johnson, N. D. Gordon, and C. L. Hanson.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1889-1895, November-December 1985. 7 fig, 5 tab, 31 ref.

Descriptors: *Model studies, *Soil erosion, *Runoff, *Sediment yield, *MUSLE, *Rainfall, *Snowmelt, *Mathematical equations, Storms, Watersheds, Rangelands, Equations, Sediments, Reynolds Creek, Prediction.

Over 1200 runoff-sediment yield events from four Reynolds Creek Experimental Watershed sagebrush rangeland areas were analyzed to test the Modified Universal Soil Loss Equation (MUSLE) for intermountain northwest United States rainfall and snowmelt conditions. Little difference was detected between sediment yields from summer rainfall and snowmelt-associated events of similar magnitude. Generally, the MUSLE underpredicted sediment yields for the largest storms events and overpredicted for the smaller events. Equations fitted to data from the study watersheds show application of the MUSLE to areas with rainfall and snowmelt runoff, and sediment yield. (Author's abstract)
W87-06656

EVENT-BASED PROCEDURE FOR ESTIMATING MONTHLY SEDIMENT YIELDS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Haith.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1916-1920, November-December 1985. 3 fig, 2 tab, 23 ref.

Descriptors: *Erosion, *Sediment yield, *Model studies, *Runoff, Transport, Temperature, Rainfall, Precipitation, Mathematical equations, Watersheds, New York, Temporal distribution, Estimating, Prediction.

A simple model is proposed for estimating the short-term sediment yields often needed in studies of nonpoint source water pollution and sediment control. The model consists of a two-stage computation which separately considers the generation of sediment supply and its subsequent transport by runoff. Inputs include daily temperature and precipitation records and parameters for the Universal Soil Loss and curve number equations. Testing over a 25-month period for an 850 sq km New York watershed indicated that the model explained 95% of the observed monthly variation of sediment yields. (Author's abstract)
W87-06660

PROBABILITY CRITERION FOR ACCEPTABLE SOIL EROSION,
Kansas Agricultural Experiment Station, Manhattan.
G. W. Cole, and J. J. Higgins.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1921-1926, 1932, November-December 1985. 6 fig, 1 tab, 14 ref.

Descriptors: *Soil erosion, *Erosion, *Productivity, *Simulation, *Mathematical equations, Risks, Tolerance, Prediction, Erosion criteria.

The soil erosion process is presently considered acceptable whenever the predicted mean of the soil erosion distribution is equal to or less than the soil loss tolerance. Another criterion is proposed, which limits the soil erosion to a specified range with an acceptable degree of risk. The rationale, required assumptions, and methods are discussed for determining this criterion, which is a function only of soil productivity. Because of this difficulty in simulation soil erosion, for the time implied by this criterion, a method is suggested for determining a short term erosion criteria. (Author's abstract)
W87-06661

TIME RESOLUTION METHODOLOGY FOR ASSESSING THE QUALITY OF LAKE SEDIMENT CORES THAT ARE DATED BY 137CS,
Department of Energy, New York. Environmental Measurements Lab.
For primary bibliographic entry see Field 5B.
W87-06678

LITTLEFIELD LAKE, MICHIGAN: CARBONATE BUDGET OF HOLOCENE SEDIMENTATION IN A TEMPERATE-REGION LACUSTRINE SYSTEM,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 2H.
W87-06679

PHOSPHORUS TRANSFER FROM SEDIMENTS BY MYRIOPHYLLUM SPICATUM,
Wisconsin Univ.-Madison. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W87-06680

WATER AND SEDIMENT SAMPLER FOR PLOT AND FIELD STUDIES,
Environmental Protection Agency, Washington, DC. Water Quality Office.
For primary bibliographic entry see Field 7B.
W87-06724

DREDGING TO REDUCE ASBESTOS CONCENTRATIONS IN THE CALIFORNIA AQUEDUCT,
California Dept. of Health Services, Sacramento. Toxics Div.
For primary bibliographic entry see Field 5G.
W87-06773

EFFECTS OF SOYBEAN AND CORN RESIDUE DECOMPOSITION ON SOIL STRENGTH AND SPLASH DETACHMENT,
Missouri Univ.-Columbia. Dept. of Agronomy.
C. J. Gantzer, G. A. Buyanovsky, E. E. Alberts, and P. A. Remley.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 202-206, January-February 1987. 2 fig, 1 tab, 22 ref. Missouri Water Resources Research Inst. Program 15.951 and USDA ARS Cooperative agreement 58-519B-3-1235.

Descriptors: *Soil stability, *Soil erosion, *Crop residues, *Splash detachment, *Shear, *Strength, *Soil strength, *Soil properties, Incubation, Decompostion, Soybeans, Corn, Stability.

Although field experiments have documented increased soil and water losses after soybeans (Glycine max L.) as compared with corn (Zea mays L.), a 'soil effect' appears to be nondetectable by regular laboratory means. Because significant differences in quantity and quality of post-harvest residues occurs between soybean and corn, a laboratory incubation experiment was designed to assess the effect of the plant materials on soil properties. Analysis shows that laboratory incubation of disturbed soil with and without corn and soybean residues at 20 C, with optimal water contents of 25% v/v, decreases splash detachment, increases shear strength and aggrevate size after 7 to 14 d. Additions of corn or soybean residues increase soil strength and decrease soil splash in a log-linear fashion. The most pronounced effects were observed after 14 d. This corresponds to peak microbiological activity, indicating changes in stability are probably related to biological processes. Corn residue at typical field rates (20 Mg/ha) reduced soil splash by about one-third and increased strength about two times as compared to the check after 14 d of incubation. Incubation with soybean residue for a similar time caused slightly greater soil splash than incubation with the same amount of corn residue, suggesting that small changes in stability are related to residue quality. No difference in soil strength relative to residue quality was detected after 14 d of incubation, indicating a subtle difference between splash and strength as measures of surface-soil stability. Aggregate size measurements were less sensitive to plant residue treatment and time of incubation than splash or strength. (Author's abstract)
W87-06806

BEDLOAD TRANSPORT IN GRAVEL-BED STREAMS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
P. Diplas.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 277-292, March 1987. 10 fig, 2 tab, 10 ref. EPA Contract R-808683-01-1.

Descriptors: *Bed load, *Sediment transport, *Stream beds, *Bedload transport, *Shields stress, Streams, Erosion, Transport, Mathematical equations, Gravel.

Field data obtained from Oak Creek were used to study the bedload transport in gravel-bed streams. A similarity approach was used to delineate a functional relationship obtained for the bedload transport rate based on a dimensional analysis reasoning. A bedload relation, which allows for sediment grading effects and is valid for low Shields stresses (phi sub 50 $<$ 1.4), was developed. A new bedload formula valid for the whole range of Shields stresses was used to predict the possible variation of the median size of the surface layer and bedload material with Shields stress. The expression for the reduced hiding function obtained suggests a dependence on Shields stress in addition to its dependence on grain size (D sub i/D sub 50). (Author's abstract)
W87-06832

SEDIMENT TRANSPORT IN OSCILLATORY FLOW OVER FLAT BEDS,
Noble Denton Associates, London (England).
R. V. Ahilan, and J. F. A. Sleath.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 308-322, March 1987. 8 fig, 1 tab, 26 ref.

Descriptors: *Sediment transport, *Unsteady flow, *Sediments, *Mathematical equations, Prediction, Transport, Oscillatory flow, Flow, Velocity, Stress, Strain, Equations.

The motion of sediment in oscillatory flow over a flat bed was investigated both theoretically and experimentally. The theory makes use of results for the relationship between stress and strain in steady flow. The experiments were performed in two different oscillatory flow water tunnels with two different sediments. They were designed to measure the variation of velocity with height in the moving layer of sediment under conditions of intense sediment transport. Although not perfect, the agreement between theory and experiment is reasonable, provided the stress ratio is chosen correctly. Calculated values of the mean sediment transport rate during a half-cycle were compared with the predictions of currently available formulas. (Author's abstract)
W87-06834

NONLINEAR MODEL FOR AGGRADATION IN ALLUVIAL CHANNELS,
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
H. Zhang, and R. Kahawita.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 353-369, March 1987. 11 fig, 1 tab, 10 ref. NSERC (Canada) Grant CNR A-8846.

Descriptors: *Model studies, *Aggradation, *Alluvial rivers, *Channels, *Sediment transport, Numerical analysis, Calibrations.

A nonlinear parabolic model for aggradation processes in alluvial rivers or channels is presented. A general exponential formula for the sediment transport relation was postulated to account for the nonequilibrium process. An indirect method for evaluating the coefficients of the sediment transport relation is described. The technique is illustrated by numerical experiment and comparison with data. Analytical expressions obtained from perturbation solutions of the characteristic parameters relevant to the aggradation process were derived. The validity of the model was assessed by comparing the analytical and numerical results with available experimental data. Good agreement was obtained. (Author's abstract)
W87-06837

DO CRITICAL STRESSES FOR INCIPIENT MOTION AND EROSION REALLY EXIST,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
J. W. Lavelle, and H. O. Mofjeld.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 370-385, March 1987. 4 fig, append.

Descriptors: *Turbulent flow, *Erosion, *Channel erosion, *Sediments, *Critical stress, *Sediment transport, *Model studies, Flumes, Velocity, Transport, Flow.

The concept of critical stress for the initial motion of noncohesive sediment beds under turbulent flow conditions is reviewed. Observational definitions of incipient motion are many and not entirely compatible. Some laboratory flume observations of sediment movement suggest that no true threshold exists. Current understanding of turbulent fluid motion at a sediment bed suggest that some particle movement must occur at all nonzero time-mean velocities. A combined model for flume flow and sediment transport having no threshold explains features of data that have been previously used to support the threshold concept. (See also W87-06839) (Author's abstract)
W87-06838

BIBLIOGRAPHY ON SEDIMENT THRESHOLD VELOCITY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 10C.
W87-06839

INFLUENCE OF CULVERT SHAPE ON OUTLET SCOUR,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. R. Abt, J. F. Ruff, F. K. Doehring, and C. A. Donnell.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 393-400, March 1987. 3 fig, 2 tab, 10 ref.

Descriptors: *Design criteria, *Scour geometry, *Erosion, *Culverts, *Outlets, *Scour, Discharge, Geometry, Prediction, Shape.

The prediction of localized scour geometry at culvert outlets has been an element in the culvert design process for determining the need for potential erosion protection. The existing scour estimation procedures have correlated the culvert diameter and discharge to the scour hole dimensions of depth, width, length and volume, primarily for circular shaped culverts. However, square, arch and rectangular culvert shapes are routinely placed in the field. It has been assumed that estimation procedures developed for circular shaped culverts adequately predict outlet scour geometry for all culvert shapes. Square, arch and rectangular culvert shapes were tested and the resulting relationships provide a data base from which a design criteria can be formulated. The experimental investigation has shown that the culvert shape significantly influences scour hole geometry. The dimensions of a scour hole that develops at the outlet of an arch, square or rectangular culvert significantly varies from the scour hole dimensions from a circular shaped culvert. (Alexander-PTT)
W87-06840

SUBMARINE BORROW PITS AS CONTAINMENT SITES FOR DREDGED SEDIMENT,
State Univ. of New York at Stony Brook. Marine

Sciences Research Center.
For primary bibliographic entry see Field 5E.
W87-06990

FLUIDIZATION APPLIED TO SEDIMENT TRANSPORT (FAST) AS AN ALTERNATIVE TO MAINTENANCE DREDGING OF NAVIGATION CHANNELS IN TIDAL INLETS,
Lehigh Univ., Bethlehem, PA. Center for Marine and Environmental Studies.
J. M. Parks, R. N. Weisman, and A. G. Collins.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 253-272, 9 fig, 1 tab, 10 ref. NOAA Grant NA-79 AAD00063.

Descriptors: *Sedimentation, *Fluidization, *Sediment transport, *Dredging, *Navigation canals, *Tidal inlets, *Corsons Inlet, *New Jersey, Bottom currents, Sand, Model studies, Pumping, Field tests, Velocity, Water currents.

Sedimentation in tidal inlets is strongly influenced by a bottom current regime that varies with the tidal cycle in both direction and velocity. This variation induces unstable shoaling and meandering of navigation channels. The concept of keeping a channel open by fluidizing the bottom sediments was suggested in New Zealand in 1969, but the idea was not pursued there. Preliminary testing of this concept in the United States indicated fundamental difficulties in achieving longitudinally continuous fluidization. Laboratory flume studies show that fully continuous fluidization along the length of the distribution pipe can be achieved when flowrates on the order of 4 l/sec/m of pipe length are used. In a two-dimensional physical model of a vertical transverse section across a fluidization system, the optimum configuration of fluidizing orifices was determined to be horizontally opposed pairs, and the practical orifice size was found to be 3.16-mm diameter for sand commonly found in inlets. The studies were then extended to the third dimension in a flume with a 3-m fluidization distribution pipe buried in sand. An orifice spacing on 5-cm centers appears to be nearly optimum. Uneven burial depth along the length of the fluidization pipe does not appear to be a problem. A series of experiments were performed to determine quantitatively the relationships between the width of the fluidized zone and the flow rate through the fluidizing pipe for different configurations of the flume system. Fluidized sand was removed from the channel by pumping of the sand-water slurry, gravity flow down a gentle slope, and by erosion by bottom currents of sufficient velocity. Currents of about 80 cm/sec velocity eroded fluidized sand without affecting nearby unfluidized sediment. When fluidized sand was removed, the sides of the channel slumped and were fluidized and were removed, increasing the channel width by 50%. Limited-scale field tests were performed in a natural environment in the margins of Corsons Inlet, southern New Jersey. Although some unanticipated operational problems were encountered, the results of the laboratory studies weresubstantiated. (See also W87-06979) (Author's abstract)
W87-06992

ACOP CANALS EQUILIBRIUM DATA VOLUME X: SUMMARY OF 1974-1980 DATA,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
K. Mahmood, M. I. Haque, A. M. Choudri, T. Masood, and M. A. Malik.
Available from the National Technical Information Service, Springfield, VA 22161as PB86-167780. Price codes: A22-PC in papercopy, A01-MF in microfiche. Report No. EWR-84-2, October 1984. 511 p, 37 fig, 1 tab, 44 nd.

Descriptors: *Canals, *Sedimentation, *Channel flow, *Pakistan, *Data collections, *Channel morphology, Alluvial rivers, Alluvial channels, Hydraulic properties, Sediment transport, Field tests.

The research on large sand bed channels of Pakistan was conducted under a binational U.S.A.-Pakistan Cooperative Program to obtain field data to verify and extend existing knowledge on the mechanics of alluvial channels. Field experiments were conducted under the Alluvial Channel Observation Project (ACOP) to obtain data on the hydraulic, sedimentation and morphologic aspects of alluvial channels. One of the objectives of the research program is to develop predictive relations for the behavior of straight sand bed channels flowing in an equilibrium state. In order to achieve this goal, equilibrium experiments were conducted on straight channel reaches of one to two mile lengths, which were in a visible sediment inflow-outflow balance. To further ensure equilibrium conditions, field measurements were made only after the channel discharge had remained steady for at least two days. The present report, being the last volume of the series, summarizes the equilibrium data reported in previous volumes. The series is organized into 10 volumes, and Volume I appeared in August 1980. (Author's abstract)
W87-07009

BED-FORM DATA IN ACOP CANALS - EQUILIBRIUM RUNS 1979-1980,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W87-07010

SEDIMENTATION,
For primary bibliographic entry see Field 5F.
W87-07040

IMPORTANCE OF SEDIMENT SULFATE REDUCTION TO THE SULFATE BUDGET OF AN IMPOUNDMENT RECEIVING ACID MINE DRAINAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W87-07109

DEVICE FOR SAMPLING THE MUD-WATER INTERFACE IN EUTROPHIC LAKES AND BOGS FOR RESIDUE ANALYSIS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 7B.
W87-07138

DISTRIBUTION OF FINE SEDIMENT DEPOSITS IN COMPOUND CHANNEL SYSTEMS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
C. S. James.
Water S. A. WASADV, Vol. 13, No. 1, p 7-14, January 1987. 9 fig, 20 ref.

Descriptors: *Sediment transport, *Mathematical models, *Channel flow, *Model studies, Flood plains, Channels, Suspended solids, Turbulent flow, Differential equations, Sediments.

During periods of high flow in compound channel systems, suspended sediment is transferred to flood plain sections by convection and by turbulent interaction between flow regions. This transfer has a significant effect on the distribution of suspended and deposited material. The complex, three-dimensional problem of describing the vertical, transverse, and longitudinal distribution of suspended material in a compound channel system is solved by decomposition. Two numerical models are presented which can be used conjunctively to describe the suspended distribution as well as the distribution of deposits on the main channel and flood plain surfaces. One model describes the vertical and transverse distributions over the flood plain and the other describes the vertical and longitudinal distributions along the main channel. These models consider steady, longitudinally uniform flow and do not account for bed load movement or the role of the bed as a source of suspended material. Application of the models is illustrated by a hypothetical example. The models have been used to explain distributions of heavy minerals in ancient fluvial systems and could also be useful for pollution studies. (Author's abstract)
W87-07149

REVIEW OF SEDIMENT/WATER QUALITY INTERACTION WITH PARTICULAR REFERENCE TO THE VAAL RIVER SYSTEM,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5B.
W87-07150

SEDIMENTOLOGIC AND GEOMORPHIC VARIATIONS IN STORM-GENERATED ALLUVIAL FANS, HOWGILL FELLS, NORTHWEST ENGLAND,
New Mexico Univ., Albuquerque. Dept. of Geology.
S. G. Wells, and A. M. Harvey.
Geological Society of America Bulletin BUGMA, Vol. 98, No. 2, p 182-198, February 1987. 10 fig, 3 tab, 39 ref.

Descriptors: *Alluvial fans, *Sediment transport, *Storm runoff, *Sedimentation, *Geomorphology, Storms, Overland flow, Geomorphology, Catchment areas, Sedimentology, England.

In June 1982, a storm with a return period greater than 100 years, but lasting less than 2.5 hr, destabilized hillslopes and produced a suite of geomorphologically and sedimentologically diverse alluvial fans. Thirteen major fans were deposited at the tributary junctions between small (< 1.0 sq km) catchments and two north-flowing headwater streams of the River Lune. Storm generated fans spread over or became inset into older stable fans and produced both localized vertical accretion (up to 3 m) and lateral accretion (up to 100 m). Sedimentary processes operating during deposition involved debris flow, transitional flow, and streamflow. Six facies types are recognized: viscous debris flow (D1), dilute debris flow (D2), transitional flow (T1), fluvial bars and lobes (S1, S2) and fluvial sheet gravels (S3). Regionally, streamflow deposition prevails over debris-flow deposition, and type S3 facies has the greatest areal extent. Temporal and spatial variations in facies deposition during the storm, however, resulted from water:sediment ratio variations. Fan deposition involved an early phase of debris-flow to transitional flow due to large inputs of sediment from hillslope failures. This was followed by a systematic change to more dilute conditions, resulting in streamflow deposition and (eventually) channel incision. A significant amount of geomorphic work and complex variations in sedimentary processes during the storm resulted, in part, from extensive overland flow and hillslope destabilization. Analysis indicates that catchment size, channel gradient and percentage of area eroded during the storm controlled whether debris flow or streamflow facies dominated a fan sequence. Smaller, steeper catchments had a greater percentage of the area yielding sediment and are dominated by debris flows, whereas larger catchments produced more runoff resulting in dilution and streamflow. Facies sequences and fan entrenchment in the Howgill Fells, which are typically considered products of longer term climatic change or tectonics in other localities, are here primarily affected by thresholds related to catchment geomorphology, by type of sediment available, and by position within the storm cell. (Author's abstract)
W87-07158

ISOTOPIC EVIDENCE FOR CLIMATIC INFLUENCE ON ALLUVIAL-FAN DEVELOPMENT IN DEATH VALLEY, CALIFORNIA,
Texas Tech Univ., Lubbock. Dept. of Geography.
R. I. Dorn, M. J. de Niro, and H. O. Ajie.
Geology GLGYB, Vol. 15, No. 2, p 108-110, February 1987. 3 fig, 2 tab, 25 ref. National Geographic Society Grant NGS 84-2961, PRF Grant 180 16-GB2, NSF Grants BNS 84-18280 and PCM 84-05003.

Descriptors: *Alluvial fans, *Paleoclimatology, *Arid climates, *Climatic effects, *Sedimentation, Death Valley, Isotope studies, Organic matter, Semiarid climates, Humid climates.

At least three semiarid to arid cycles are recorded by delta C13 values of organic matter in layers of rock varnishes on surfaces of Hanaupah Canyon and Johnson Canyon alluvial fans, Death Valley, California. These isotopic paleoenvironmental signals are interpreted as indicating major periods of fan aggradation during relatively more humid periods and fan entrenchment during subsequent lengthy arid periods. (Author's abstract)
W87-07159

CAPILLARY MOISTURE FLOW AND THE ORIGIN OF CAVERNOUS WEATHERING IN DOLERITES OF BULL PASS, ANTARCTICA,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
For primary bibliographic entry see Field 2G.
W87-07162

TRANSPORT OF ROAD-SURFACE SEDIMENT THROUGH EPHEMERAL STREAM CHANNELS,
Weyerhaeuser Co., Tacoma, WA.
For primary bibliographic entry see Field 5B.
W87-07186

VALIDATION OF SWRRB-SIMULATOR FOR WATER RESOURCES IN RURAL BASINS,
Agricultural Research Service, Temple, TX.
For primary bibliographic entry see Field 6B.
W87-07198

INFLUENCE OF INFREQUENT FLOODS ON THE TRACE METAL COMPOSITION OF ESTUARINE SEDIMENTS,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, and S. A. Sinex.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 1-11, October 1986. 3 fig, 2 tab, 24 ref.

Descriptors: *Sediment transport, *Trace metals, *Estuaries, *Flood effects, *Sediment sources, Chesapeake Bay, Susquehanna River, Iron, Flood discharge, River basins, Sediments, Heavy metals.

By use of iron variation diagrams, it is shown that the concentrations of Mn, Ni, Cu and Zn in sediments of upper Chesapeake Bay are 50-75% lower than expected if they were simple mixtures of their apparent source materials: eroding Atlantic Coastal Plain deposits and material delivered by the Susquehanna River under ordinary discharge conditions. The Fe concentrations in the sediments, on the other hand, are consistent with derivation from these sources. Evidence is presented that the ratios of total Mn, Ni, Cu and Zn to Fe in the Susquehanna River decline during high discharge events. Because such events are responsible for removal of a major fraction of the total material carried out of the river basin, it is likely that the upper bay sediments simply reflect the long-term average composition of material from the basin. Averaging over a period much greater than one year is necessary to obtain a meaningful estimate of the trace element composition of material being removed from this river basin. (Author's abstract)
W87-07212

TRACE METAL SEASONAL VARIATIONS IN TEXAS MARINE SEDIMENTS,
Geological Survey, Denver, CO.
C. W. Holmes.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 13-27, October 1986. 10 fig, 27 ref.

Descriptors: *Sediment transport, *Trace metals, *Marine sediments, *Sediment sources, *Seasonal variation, *Coastal waters, Texas, Watersheds, Effluents, Chemical precipitation, Harbors, Sediments, Transport, Corpus Christi.

Trace elements in coastal environments are derived from three major sources: (1) the bordering watershed; (2) the offshore marine environment; and (3) industrial and/or urban effluent. The site of deposition, however, is controlled by physical and chemical processes in the coastal zone. In many cases, these processes are controlled by climate and can vary seasonally. In the harbor at Corpus Christi, Texas, the summer climate creates an oxygen-poor environment in the water column near the sediment-water interface. This causes chalcophilic metals to precipitate from the water, resulting in high concentrations in the sediments near the source. During the winter, turbulence created by strong winds causes the entire water mass to become aerated and oxidizing, and remobilization of some metals results. In addition, this turbulence accelerates circulation which transports the metal-enriched waters from the harbor. On the outer continental shelf of south Texas, the infaunal activity varies seasonally with bottom water temperatures. As this infaunal activity has an effect on the chemical environment within the sediment near the sediment-water interface, the observed trace metal content at the interface also appears to change with the seasons. (Author's abstract)
W87-07213

TRACE METAL TRANSPORT IN TWO TRIBUTARIES OF THE UPPER CHESAPEAKE BAY: THE SUSQUEHANNA AND BUSH RIVERS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. J. Delfino, and R. G. Otto.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 29-44, October 1986. 5 fig, 1 tab, 31 ref.

Descriptors: *Trace metals, *Sediment transport, *Chesapeake Bay, *Sediment sources, *Suspended load, *Susquehanna River, *Bush River, Seasonal variation, Rivers, Sediments, Hydrology, Heavy metals, Metals.

A study of Fe, Mn, Zn, and Cu transport in two tributaries of the Upper Chesapeake Bay (the Susquehanna and Bush Rivers) was performed. Sampling was conducted according to hydrologic seasons. Three phases (soluble (<0.2 micron), fine (>0.2 micron, <3 micron) and coarse particulates (>3 micron)) of each metal were separated by rapid filtration and then analyzed. Particulate Fe was the major Fe phase in both rivers during all seasons. Soluble Mn was the dominant Mn phase in winter in both rivers and also during fall and the snowmelt-runoff period in the Susquehanna River and summer at one Bush River station. Soluble Zn was the principal Zn phase in winter in both rivers and also in summer in the Susquehanna River, while particulate Zn was dominant during the remaining seasons. Copper showed the greatest prevalence in the soluble phase among the four metals studied. The soluble phase was the major form of Cu during fall, winter and spring in both rivers and also in summer in the Susquehanna River. The trace metal phase distributions were related to seasonal hydrologic conditions and water chemical phenomena, such as the release of Mn from anoxic sediments. The metal content of total suspended matter in the rivers was at least the same order of magnitude as seen for other world rivers, although the Fe and Mn contents in the total suspended matter were enriched above the world averages on some sampling dates in both the Susquehanna and Bush Rivers. The content of all four metals in the total suspended matter was greater than would be predicted based on the weathering of exposed surficial rock, indicating the contribution of anthropogenic sources to the total particulate metal content in both rivers. (Author's abstract)
W87-07214

SEDIMENTS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
For primary bibliographic entry see Field 5B.
W87-07236

SEDIMENT RESPONSE TO SEASONAL VARIATIONS IN ORGANIC MATTER INPUT,
Quebec Univ., Rimouski. Dept. of Oceanography.
N. Silverberg, H. M. Edenborn, and N. Belzile.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 69-80, 5 fig, 1 tab, 14 ref.

Descriptors: *Organic matter, *Seasonal variation, *Sediments, *St. Lawrence River, Sedimentation rates, Mixing, Bioturbation.

Significant variations in the sedimentation rate, flux of organic matter, and in the quality of the organic matter reaching the sediment surface have been observed in a physically stable, deep coastal environment. Bioturbational mixing is sufficiently active to ensure that freshly arriving organic matter is incorporated below the sediment surface before it can be significantly degraded. Seasonal variations in the overlying water column may induce corresponding temporal variations in diagenetic parameters in the bottom sediments. The study of the St. Lawrence region is continuing, to further define the time-scales over which steady-state assumptions may be validly applied. Caution is advised when extending diagenetic rate constant determinations, based upon measurements obtained on a single date, to long-term models. (See also W87-07371) (Lantz-PTT)
W87-07375

PARTITIONING OF PCBS IN MARINE SEDIMENTS,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-07377

SILICONES IN ESTUARINE AND COASTAL MARINE SEDIMENTS,
Naval Research Lab., Washington, DC. Chemistry Div.
For primary bibliographic entry see Field 5B.
W87-07378

BUDGETS AND RESIDENCE TIMES OF NUTRIENTS IN TOKYO BAY,
Geological Survey of Japan, Yatabe. Marine Geology Dept.
For primary bibliographic entry see Field 2L.
W87-07379

SEDIMENTARY PROCESSES OF FINE SEDIMENTS AND THE BEHAVIOUR OF ASSOCIATED METALS IN THE KEUM ESTUARY, KOREA,
Seoul National Univ. (Republic of Korea). Dept. of Oceanography.
C.-B. Lee.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 209-225, 8 fig, 3 tab, 24 ref.

Descriptors: *Sediment transport, *Heavy metals, *Keum Estuary, *Korea, *Suspended sediments, Estuaries, Seasonal variation, Tides, Manganese, Zinc, Copper, Cobalt, Lead, Nickel.

The Keum Estuary is characterized by its macrotidal regime and great seasonal fluctuation in river discharge. The spring-tidal saline water penetrates up to 60-km upstream during the low river discharge period. Concentration of suspended particulate matter (SPM) varies with both velocity and direction of the tidal current, the latter being related to the concentration gradient along the estuary. The development of a turbidity maximum, extending over 40-km along the estuary during the spring-tide and low river discharge period and disappearing during the neap-tide and high river flow, seems primarily related to the tidal range at the mouth. The SPM in the maximum zone is mostly fine-grained and enriched with some heavy metals (Mn, Zn, Cu, Co, Pb and Ni) associated with the reducible and residual fractions, although some of them show certain relationships with the grain-size and the organic carbon content. (See also W87-07371) (Author's abstract)
W87-07382

TIN METHYLATION IN SULFIDE BEARING SEDIMENTS,
Maryland Univ., Solomons. Chesapeake Biological Lab.

For primary bibliographic entry see Field 5B.
W87-07383

MASS BALANCE MODELING OF HEAVY METALS IN SAGINAW BAY, LAKE HURON,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5B.
W87-07418

DETACHMENT MODEL FOR NON-COHESIVE SEDIMENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, and B. J. Barfield.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 445-449, March-April 1986. 3 fig, 12 ref.

Descriptors: *Model studies, *Sediment transport, *Bed load, *Scour, Turbulent flow, Prediction, Detention ponds, Sediments, Detachment.

A detachment algorithm was developed using Einstein's bed load transport concepts. This detachment algorithm is based on the probability of turbulent detachment forces exceeding the submerged weight of particles. In addition to the detachment algorithm, a theoretical inconsistency in Einstein's bed load formulation was corrected. The implications of this inconsistence were also discussed. The use of the algorithm was demonstrated in predicting the bed scour rate in detention ponds. These results showed that the model predicted values with proper trends. (Author's abstract)
W87-07449

SPILLWAY DESIGN AFFECTS RESERVOIR WATER QUALITY,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
For primary bibliographic entry see Field 8A.
W87-07452

EROSION, DEPOSITION AND SEDIMENT YIELD FROM DRY CREEK BASIN, NEBRASKA,
R. G. Spomer, R. L. Mahurin, and R. F. Piest.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 489-493, March-April 1986. 3 fig, 3 tab, 12 ref.

Descriptors: *Erosion, *Deposition, *Sediment yield, *Dry Creek Basin, *Soil erosion, Nebraska, *Sedimentation, Basins, Drainage areas, Croplands.

Historic and contemporary erosion measurements on channels, gullies, and rangeland, along with computed erosion rates from cropland, were utilized to attempt a total accounting of sedimentation (erosion and deposition) processes in the Dry Creek Drainage Basin, Nebraska. Previously, such accountings could only be inferred from information at extreme ends of space/time reference frames, i.e. from very small 40.5 sq m(0.01 acre) erosion plot measurements on a storm or an annual basis, and for large basins over geologic time. Additional measures of component sedimentation processes as cited herein are essential for model verification. Better information on the dynamics of soil erosion, transport, and especially sediment delivery and deposition is provided to improve conservation designs. Thirty year, watershed weighted, average annual sediment yields of 10.3 Mg/ha (4.6 t/a) from the 51.8 sq km (20 sq mi) drainage area of Dry Creek originated from the following source areas: cropland soil erosion (8.1 Mg/ha (3.6 t/a)), rangeland soil erosion (0.7 Mg/ha (0.3 t/a)), catstep soil erosion (3.1 Mg/ha (1.4 t/a)), upland gully knickpoint erosion (1.1 Mg/ha (0.5 t/a)), main channel widening 1.9 Mg/ha (0.8 t/a), and main channel headcutting 0.6 Mg/ha (0.3 t/a). Thirty year average annual deposition quantities, watershed weighted were: 5.9 Mg/ha (2.6 t/a), with 0.7 Mg/ha (0.3 t/a) filling the middle channel reaches of Dry Creek, 4.8 Mg/ha (2.1 t/a) accumulating on the flat floodplain, and the remaining 0.4 Mg/ha (0.2 t/a) deposited on the same general location from which it was eroded. (Author's abstract)
W87-07456

CHANGES IN THE DISTRIBUTION PATTERNS OF TRACE METALS IN SEDIMENTS OF THE MERSEY ESTUARY IN THE LAST DECADE (1974-83),
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5B.
W87-07466

GEOSTATISTICAL MODEL OF RESERVOIR DEPOSITION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
A. Bardossy, I. Bogardi, and L. Duckstein.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 510-514, March 1987. 1 fig, 1 tab, 17 ref. FAO Project HUN.82004.

Descriptors: *Sedimentation, *Model studies, *Reservoir deposition, *Silting, *Geostatistics, *Kriging, Hungary, Estimating, Reservoirs, Deposition, Statistics.

The estimation variance of reservoir deposition volume is calculated from point measurements by geostatistics. Two versions of the geostatistical model are developed: a trapezoidal rule estimator and universal kriging estimator. The geostatistical properties of the trapezoidal rule estimator are derived. To illustrate the approach, the estimation variance of reservoir deposition volume at the Vacszentlaszlo site (Hungary) is calculated by four methods: statistical procedure under spatial independence assumption (1) prior to measurements; (2) after measurements; (3) geostatistical use of trapezoidal rule; and (4) universal kriging. Results indicate that the assumption of spatial independence leads to considerable underestimation of the error. It is shown both theoretically and numerically that the trapezoidal rule estimator and universal kriging may yield similar results. (Author's abstract)
W87-07481

SEDIMENTS OF LAKE BALDEGG (SWITZERLAND) - SEDIMENTARY ENVIRONMENT AND DEVELOPMENT OF EUTROPHICATION FOR THE LAST 100 YEARS (DIE SEDIMENTE DES BALDEGGERSEES (SCHWEIZ) - ABLAGERUNGSRAUM UND EUTROPHIERUNGSENTWICKLUNG WAHREND DER LETZTEN 100 JAHRE),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geologisches Inst.
For primary bibliographic entry see Field 2H.
W87-07527

SINKING RATES AND PHYSICAL PROPERTIES OF FAECAL PELLETS OF FRESHWATER INVERTEBRATES OF THE GENERA SIMULIUM AND GAMMARUS,
Freshwater Biological Association, Wareham (England). River Lab.
M. Ladle, J. S. Welton, and M. C. Bell.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 411-424, January 1987. 6 fig, 29 ref.

Descriptors: *Feces, *Animal wastes, *Invertebrates, *Sediments, *Translocation, *Rivers, *Mathematical studies, Mathematical equations, Sinking rates, Physical properties, Aquatic animals, Amphipods, Crustaceans, Gammarus, Larvae, Animal wastes, Wastes, Stokes Law.

The physical properties and sinking rates of the fecal pellets of a larval suspension feeder (Simulium spp.) and a benthic crustacean deposit feeder (Gammarus pulex) are discussed in relation to the translocation of organic sediments in rivers. Fluid viscosity was important in the settling of Simulium fecal pellets but not G. pullex pellets and the drag coefficients are calculated compared with the theoretical Stokes Law. Physical factors affecting the rates included pellet diameter, length, and specific gravity. Equations are also derived to predict pellet sinking rates. (Author's abstract)
W87-07529

RAINFALL'S THE GAME, EDUCATION'S THE AIM,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 2B.
W87-07561

RAINFALL EROSIVITY IN IRAQ,
Salahaddin Univ., Arbil (Iraq). Dept. of Soil Science.
M. H. Hussein.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 5, p 336-338, September-October 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Rainfall erosivity, *Iraq, *Rill erosion, *Sheet erosion, *Mathematical analysis, *Rainfall, *Erosion, Prediction, Soil erosion, Mathematical equations, Regression analysis, Erosion control.

An estimation of rainfall erosivity is essential for the prediction of sheet and rill erosion. However, a rainfall erosivity parameter designed specifically for Iraq cannot be derived currently, since soil loss data for the country are scarce. Therefore, an attempt was made to approximate rainfall erosivity in Iraq using available information on monthly and annual rainfall for 49 stations covering the country. An isoerodent map was developed for the entire country; values for points between isoerodent lines can be calculated using linear interpolation. However, such interpolation is less valid in the mountainous region because index values change rather abruptly. A probability analysis on erosivity factor cannot yet be made. However, individual year erosivity values may deviate appreciably from the mean annual erosivity. Also, the effect of snowmelt in the mountain region is not accounted for. Nevertheless, derived values are considered satisfactory as a first approximation to rainfall erosivity. Erosivity values have been used to predict sheet and rill erosion with the universal soil loss equation in northern Iraq, specifically to assess erosion hazards on farm fields and to design proper erosion control measures. (Author's abstract)
W87-07563

EARLY DIAGENESIS IN BIOADVECTIVE SEDIMENTS: RELATIONSHIPS BETWEEN THE DIAGENESIS OF BERYLLIUM-7, SEDIMENT REWORKING RATES, AND THE ABUNDANCE OF CONVEYOR-BELT DEPOSIT-FEEDERS,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
D. L. Rice.
Journal of Marine Research JMMRAO, Vol. 44, No. 1, p 149-184, February 1986. 10 fig, 5 tab, 40 ref. NOAA Grant NA81AA-D-00099, NSF Grants OCE-8310178 and OCE-8442759.

Descriptors: *Limnology, *Isotope studies, *Diagenesis, *Sediments, *Beryllium, *Sedimentation, *Polychaetes, *Model studies, *Marine environment, Annelids, Intertidal areas, Particulate matter, Environment, Organic matter, Detritus, Aquatic animals, Aquatic life, Sedimentation rates, Mathematical models, Mathematical studies, Mathematical analysis.

The contribution of the conveyor-belt feeding and biodeposition activity of orbiniid polychaetes (Scoloplos spp.) to bioturbation in intertidal sediments was examined in Lowes Cove, Maine. Laboratory measurements of particle reworking rates were incorporated into steady-state and transient-state diagenetic models to predict subduction velocities of marker layers in incubated cores and to predict the in situ activity-depth profile of the radionuclide Be-7, a tracer of rapid mixing processes. Incubated cores containing a complete macrofauna from the Cove were mixed bioadvectively with little random mixing detectable; the conveyor-belt activity of Scoloplos accounted fully for particle subduction in these cores. The Be-7 activity-depth profile of a sediment core from Lowes Cove was consistent with a conveyor-belt diagenetic model based upon seasonal variations in the surface biodeposition rate of Scoloplos and a constant Be-7 activity at the sediment surface. Seasonal changes in the rates of atmospheric deposition and dilution with radioactively dead sediment emplaced by

conveyor-belt activity apparently did not dominate features of this Be-7 profile. The control by these polychaetes of sediment turnover and incorporation of reactive chemical species across the sediment surface may explain in part why local patches with characteristic worm abundance and standing crop are maintained year to year in Lowes Cove. (Author's abstract)
W87-07594

2K. Chemical Processes

NUMERICAL MODEL FOR SULFUR AND NITROGEN SCAVENGING IN NARROW COLD-FRONTAL RAINBANDS: 1. MODEL DESCRIPTION AND DISCUSSION OF MICROPHYSICAL FIELDS,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W87-06699

NUMERICAL MODEL FOR SULFUR AND NITROGEN SCAVENGING IN NARROW COLD-FRONTAL RAINBANDS: 2. DISCUSSION OF CHEMICAL FIELDS,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W87-06700

OZONE-INDUCED OXIDATION OF SO2 IN SIMULATED CLOUDS,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2B.
W87-06701

ION-ASSOCIATION MODEL FOR HIGHLY SALINE, SODIUM CHLORIDE-DOMINATED WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, and S. J. Traina.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 80-85, January-March 1987. 3 fig, 3 tab, 27 ref.

Descriptors: *Ion-association models, *Model studies, *Solutions, *Saline water, *Water chemistry, *Sodium chloride, *Solutes, *GEOCHEM, Statistics, Computer programs, Model testing, Calibrations, Prediction, Solubility, Speciation, Soil solution, Brines, Ions, Electrolytes.

An empirical ion-association model for concentrated aqueous solutions in which NaCl is the principal solute was developed for incorporation into the computer program GEOCHEM. The model involved the use of the Davies equation to calculate the activity coefficients of charged species and other semiempirical equations based in statistical mechanics to calculate the activity coefficients of neutral complexes. Model validation was initiated through prediction of the solubilities of gypsum, amorphous silica, and barite in NaCl solutions and other Na-salt solutions. Predicted solubilities usually agreed with measured values to within + or 5 5% at ionic strengths up to 2 kmol/cu m (mol/L). These encouraging results suggest that the model, although limited in scope and validation, will be useful for chemical speciation calculations on highly saline soil solutions and brines. (Author's abstract)
W87-06728

DIFFERENTIAL-PULSE POLAROGRAPHIC DETERMINATION OF SELENIUM SPECIES IN CONTAMINATED WATERS,
Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Analytical Chemistry Section.
For primary bibliographic entry see Field 5A.
W87-06730

DIRECT DETERMINATION OF CADMIUM IN NATURAL WATERS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITHOUT MATRIX MODIFICATION,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5A.
W87-06731

IDENTIFICATION OF HYDROLYSIS PRODUCTS OF ALUMINIUM IN NATURAL WATERS: PART 1. N-DIMENSIONAL CALIBRATION OF AL/F KINETIC PATHWAYS,
Goettingen Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-06732

IDENTIFICATION OF HYDROLYSIS PRODUCTS OF ALUMINIUM IN NATURAL WATERS: PART 2. ALSPEC, A COMPUTERIZED PROCEDURE FOR QUANTIFYING EQUILIBRIA WITH INORGANIC AND ORGANIC LIGANDS,
Goettingen Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-06733

DETERMINATION OF TRACE AMOUNTS OF VANADIUM(IV) AND (V) IN WATER BY ENERGY-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY COMBINED WITH PRECONCENTRATION AND SEPARATION,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
K. Hirayama, and D. E. Leyden.
Analytica Chimica Acta ACACAM, Vol. 188, p 1-7, October 1986. 2 fig, 3 tab, 16 ref.

Descriptors: *Vanadium, *Analytical methods, *Sample preparation, *X-ray florescence spectrometry, Precipitates, Spectral analysis, Ions, Heavy metals.

In a method is described for the separation, preconcentration and quantitation of V(IV) and V(V) in water. Vanadium(V) is precipitated with diethyldithiocarbamate (DDTC) at pH 1.8 and V(IV) is precipitated with DDTC at pH 4. The precipitates are collected by vacuum filtration on a membrane filter for quantitation by energy-dispersive x-ray fluorescence spectrometry. Multi-element and single-element calibration curves are prepared and used to evaluate the matrix and mass effects of diverse ions such as Fe(III), Co(II), Ni(II), Cu(II), Zn(II) and Pb(II). The total amount of metal ions should not exceed about 100 microgram. The V(IV) and V(V) are separated completely and recovered quantitatively. (Author's abstract)
W87-06734

FLUORIDE ION-SELECTIVE ELECTRODE IN FLOW INJECTION ANALYSIS: PART 3. APPLICATIONS,
Hahn-Meitner-Inst. fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-06735

DETERMINATION OF ALUMINIUM IN SEAWATER AND FRESHWATER BY CATHODIC STRIPPING VOLTAMMETRY,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W87-06736

EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF ZINC IN COAL FLY ASH AND POND SEDIMENTS WITH 2-(2-(3,5-DIBROMOPYRIDYL)AZO)-5-DIMETHYLAMINOBENZOIC ACID,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
For primary bibliographic entry see Field 5A.
W87-06737

DETERMINATION OF SELECTED TRACE METALS IN SCALLOPS BY FLAME ATOMIC ABSORPTION SPECTROMETRY AFTER REMOVAL OF SODIUM ON HYDRATED ANTIMONY PENTOXIDE,
Brandon Univ. (Manitoba). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-06738

DETERMINATION OF MICROGRAM AMOUNTS OF ARSENIC IN GEOLOGICAL MATERIALS AND WATERS BY WAVELENGTH-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY,
Saint Mary's Univ., Halifax (Nova Scotia). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-06739

INFLUENCE OF CATION ACIDS ON DISSOLVED HUMIC SUBSTANCES UNDER ACIDIFIED CONDITIONS,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-06759

COAGULATING BEHAVIORS OF FE(III) POLYMERIC SPECIES-I: PREFORMED POLYMERS BY BASE ADDITION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
T. Hong-Xiao, and W. Stumm.
Water Research WATRAG, Vol. 21, No. 1, p 115-121, January 1987. 8 fig, 24 ref.

Descriptors: *Coagulation, *Chemical reactions, *Iron, *Preformed polymers, *Solutions, Hydrolysis, Polymerization, Precipitation, Acids, Bases, Speciation, Spectral analysis, Kaolinite.

The hydrolysis-polymerization-precipitation processes of Fe(III) in solution with acid-base addition can be characterized by a parameter B* =OH/Fe ratio calculated by a method suggested in this paper. The classification of solutions by B* is self-consistent in their performances as pH evolution with time, absorption spectrum, chemical speciation and coagulating behaviors. The preformed Fe(III) solution of type B* =0.5-1.0 exhibited the optimum ability to coagulate kaolinite suspensions. (See also W87-06763) (Author's abstract)
W87-06762

COAGULATING BEHAVIORS OF FE(III) POLYMERIC SPECIES-II: PREFORMED POLYMERS IN VARIOUS CONCENTRATIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
T. Hong-Xiao, and W. Stumm.
Water Research WATRAG, Vol. 21, No. 1, p 123-128, January 1987. 8 fig, 17 ref.

Descriptors: *Coagulation, *Chemical reactions, *Iron, *Preformed polymers, *Solutions, Acids, Bases, Polymers, Comparison studies.

Ferric solutions of various concentrations can be characterized by the parameter B*(=OH/Fe ratio, the formation function) and classified into similar types as for the solutions with acid base addition. The directly dosed solution of Fe(III) is also treated like a preformed coagulant. The effects of coagulation of preformed ferric polymer coagulants were compared with those of polyaluminum chloride and organic polymer flocculants. Integrations of polymeric species with particle surface are discussed. (See also W87-06762) (Author's abstract)
W87-06763

INFLUENCE OF BUFFER CAPACITY, CHLORINE RESIDUAL, AND FLOW RATE ON CORROSION OF MILD STEEL AND COPPER,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5F.
W87-06777

RAPID DETERMINATION OF METHYL MERCURY IN FISH AND SHELLFISH: METHOD DEVELOPMENT,
Food and Drug Administration, Washington, DC. Contaminants Chemistry Div.
For primary bibliographic entry see Field 5A.
W87-06788

EXTRACTION AND DETERMINATION BY GAS CHROMATOGRAPHY OF S,S,S-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) IN FISH AND WATER,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5A.
W87-06789

X-RAY PHOTOELECTRON STUDIES OF ANION ADSORPTION ON GOETHITE,
University of Western Ontario, London. Dept. of Chemistry.
R. R. Martin, and R. S. C. Smart.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 54-56, January-February 1987. 4 tab, 16 ref.

Descriptors: *X-ray photoelectron spectroscopy, *Path of pollutants, *Analytical methods, *Anion adsorption, *Goethite, Adsorption, Anions, Minerals, Phosphates, Sulfates, Selenium, Performance evaluation.

X-ray photoelectron spectroscopy (XPS) was evaluated as a technique to study anion adsorption on soil minerals; in this case, the well-characterized systems of phosphate, sulfate, and selenite adsorption on goethite (alpha-FeOOH). X-ray photoelectron spectroscopy measured directly the surface coverage, the form of the adsorbed species and substrate, and the pH dependence of adsorption. The results confirm the previously reported adsorption mode in which two A-type hydroxyls are replaced by coordination of two of the oxygen atoms of the anion. (Author's abstract)
W87-06799

ALUMINUM SPECIATION: A COMPARISON OF FIVE METHODS,
Clemson Univ., SC. Dept. of Computer Engineering.
S. C. Hodges.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 57-64, January-February 1987. 4 fig, 3 tab, 34 ref. EPA/North Carolina State Univ. Acid Precipitation Program APP0094-1981, Project F2-9.

Descriptors: *Comparison studies, *Aluminum, *Speciation, *Analytical methods, Ion exchange, Chelating resins, Electrodes, Stability constants, Prediction, Performance evaluation, Solutions, Soil solution, Complexes, Fulvic acids, Organic matter.

Five methods with varying chemical approaches to the speciation of Al were compared. The 8-hydroxyquinoline (HQ) and ferron procedures were used to estimate the inorganic, monomeric forms of Al at reaction times of 15 and 30 s, respectively. An ion exchange column procedure and a chelating resin procedure, were used primarily to measure organically bound forms of Al. These were compared with a F electrode technique. Stability constants are then used to calculate the speciation of inorganic forms of Al, and organically complexed forms are obtained by subtraction from total Al. Sample solutions containing 5 mmol/cu m F, and 7.9, 15.2, 44.5, and 80.4 mmol/cu m Al were synthesized, with and without addition of 1 mol/cu m (as dissolved organic C) purified fulvic acid extracted from the surface horizon of an Edneytown soil (Typic Hapludults). Excellent agreement between predicted and measured Al(3+) was obtained for the electrode procedure in solutions without organic matter (OM). The kinetically reactive Al values obtained by the HQ procedure correlated very well with those of the F electrode procedure. The kinetically reactive Al values obtained by the ferron procedure were greater than values obtained by the HQ and electrode procedures. The column and chelating resin procedures were able to separate organic and inorganic forms of Al only, thus speciation of inorganic complexes was not feasible. Organically bound Al calculated from the electrode procedure was generally lower but consistent with the values obtained by the chelating resin. The ion exchange column procedure gave the lowest values of Al-OM at the lowest Al/OM ratios, indicating that some degradation of Al-OM complexes may occur during passage through the column. The F electrode procedure, though promising, should not be indiscriminately used over a wide range of pH, Al/F ratios, and DOC contents. The procedure is slow and requires the assumption of equilibrium conditions, which may seldom occur for Al in field conditions. It is, however, promising as a tool for the evaluation of other procedures. (Author's abstract)
W87-06800

SINGLE COLUMN ION CHROMATOGRAPHY: III. DETERMINATION OF ORTHO-PHOSPHATE IN SOILS,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
U. Karlson, and W. T. Frankenberger.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 72-74, January-February 1987. 3 fig, 3 tab, 13 ref.

Descriptors: *Soil solutions, *Orthophosphates, *Chromatography, *Analytical methods, Detection limits, Chlorides, Nitrates, Ions, Performance evaluation.

A chromatographic procedure was developed to determine orthophosphate in aqueous soil extracts by single column ion chromatography (SCIC) with conductimetric detection. The eluent stream consisted of 1.5 mM phthalic acid adjusted to pH 2.7 with formic acid. The method allows precise (RSD = 1.1-3.3%) measurements of trace amounts of orthophosphate (detection limit = 0.3 microgram/L) in the presence of high background levels of Cl(-) and NO3(-). Analysis of orthophosphate by SCIC closely agrees to those values obtained with an AutoAnalyzer based on the Mo blue chromophore reaction. Under the chromatographic conditions described, elution of orthophosphate occurred at 6 min while Cl(-) and NO3(-) had respective retention times of 11 and 20 min. Single column ion chromatography proves to be a rapid and routine method for determination of orthophosphate with greater sensitivity than the conventional colorimetric methods. (Author's abstract)
W87-06802

SIGNIFICANCE OF SULFIDE OXIDATION IN SOIL SALINIZATION IN SOUTHEASTERN SASKATCHEWAN, CANADA,
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
For primary bibliographic entry see Field 2G.
W87-06808

THREE-MINUTE ANALYSIS OF CHLORIDE, NITRATE, AND SULFATE BY SINGLE COLUMN ANION CHROMATOGRAPHY,
Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
For primary bibliographic entry see Field 5A.
W87-06810

CHAPARRAL CONVERSION AND STREAMFLOW: NITRATE INCREASE IS BALANCED MAINLY BY A DECREASE IN BICARBONATE,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
For primary bibliographic entry see Field 4C.
W87-06831

ANALYTICAL CHEMISTRY OF PCBS,
Midwest Research Inst., Kansas City, MO.
For primary bibliographic entry see Field 5A.
W87-06848

ALUMINIUM COMPLEXATION BY AN AQUATIC HUMIC FRACTION UNDER ACIDIC CONDITIONS,
Freshwater Biological Association, Ambleside (England).
C. A. Backes, and E. Tipping.
Water Research WATRAG, Vol. 21, No. 2, p 211-216, February 1987. 4 fig, 2 tab, 18 ref. EEC Contract ENV.865.UK.

Descriptors: *Acidic water, *Water chemistry, *Aluminum, *Humic acids, *Model studies, Natural waters, Binding, Complexation, Complexes.

Equilibrium dialysis and acid-base titration were used to investigate the interactions between Al and a fraction of aquatic humic substances (HS), in the pH range 3-5. Binding of Al by the HS increased with Al(3+) activity and with pH. Under conditions relevant to natural waters, nu(mol Al bound per gHS) varied from 0 to .0015. The data were modelled with an emprical linear logarithmic expression (Model I) and on the basis of the polyelectrolyte nature of the HS, incorporating competitive binding of H(+) and Al(3+) (Model II). Both models gave tolerable fits (r = 0.93). Model I is simpler to apply, while Model II allows the calculation of proton release accompanying Al binding, and provides information on the net charge of the Al-HS complexes. The results were used to calculate the distribution of Al between organic and inorganic forms under conditions prevailing in acidic natural waters. (Author's abstract)
W87-07057

COMPETITION IN DENITRIFICATION SYSTEMS AFFECTING REDUCTION RATE AND ACCUMULATION OF NITRITE,
Technische Univ. Hamburg-Harburg (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W87-07062

RAIN EVENTS IN AN ARID ENVIRONMENT - THEIR DISTRIBUTION AND IONIC AND ISOTOPIC COMPOSITION PATTERNS: MAKHTESH RAMON BASIN, ISRAEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 2B.
W87-07064

CHEMICAL SIMILARITIES AMONG PHYSICALLY DISTINCT SPRING TYPES IN A KARST TERRAIN,
Kentucky Univ., Lexington. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W87-07066

CHEMICAL COMPOSITION OF RAINFALL AND GROUNDWATER IN RECHARGE AREAS OF THE BET SHEAN-HAROD MULTIPLE AQUIFER SYSTEM, ISRAEL,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
E. Rosenthal.
Journal of Hydrology JHYDA7, Vol. 89, No. 3/4, p 329-352, January 1987. 4 fig, 5 tab, 43 ref.

Descriptors: *Water chemistry, *Rainfall, *Groundwater, *Aquifers, *Bet Shean-Harod aquifer system, *Israel, Ions, Recharge, Runoff, Flow, Salinity.

The Bet Shean and Harod valleys are regional recipients and mixing zones for groundwaters draining from a regional multiple-aquifer system comprising two different carbonate and two basalt aquifers as well as deep-seated reservoirs of confined brines. This paper, the first of two, describes the hydrochemistry of the groundwater bodies related to this multiple aquifer system. The paper deals with the chemical composition of rain falling on natural recharge areas, the chemical contribution of the aquifer rocks and the chemical evolution of groundwaters in the upper flow courses of all aquifers of this regional system. The methodology applied is based on the determination of major

dissolved ions and on the examination of their ratios and changes along the upper flow paths. Rain water falling on natural recharge areas has an average chlorinity of 12 mg/l Cl(-) and a calcium bicarbonate composition caused by dust-borne terrigenous material. This rain-water salinity decreases with distance from the sea-shore. Fresh groundwaters flowing through the different aquifers may be identified and differentiated by their characteristic salinity levels and ionic ratios. Groundwaters flowing through carbonate aquifers are identified by different salinity levels and by distinct rMg/rCa ratios reflecting dolomite-calcite ratios in aquifer rocks. The groundwaters of the two basalt aquifers have typical cation assemblages and high Na(+) and Mg(2+) concentrations, far in excess of those typical of the recharging rainfall. Groundwater in the upper flow courses of all aquifers investigated is deficient in SO4(2-) and K(+) relative to recharging rain water. (Author's abstract)
W87-07069

ESTIMATION OF BACTERIAL NITRATE REDUCTION RATES AT IN SITU CONCENTRATIONS IN FRESHWATER SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 5A.
W87-07075

INVESTIGATION OF THE MULTIELEMENT CAPABILITY OF LASER-ENHANCED IONIZATION SPECTROMETRY IN FLAMES FOR ANALYSIS OF TRACE ELEMENTS IN WATER SOLUTIONS,
Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Fysik.
O. Axner, I. Magnusson, J. Petersson, and S. Sjostrom.
Applied Spectroscopy APSPA4, Vol. 41, No. 1, p 19-26, January 1987. 1 fig, 3 tab, 18 ref.

Descriptors: *Water analysis, *Measuring instruments, *Analytical methods, *Heavy metals, *Ionization spectroscopy, *Spectroscopy, *Lasers, *Trace elements, *Atomic absorption spectroscopy, Ionization, Detection limits.

One-step Laser Enhanced Ionization (LEI) spectrometry of 23 different elements in aqueous solutions was performed in an acetylene/air flame. All elements were detected by light in the ultraviolet region, produced by frequency doubling of the output from the dye Coumarin 153. This was done in order to investigate the multielement capability in flames that was made possible by the recent development of commercially available, widely tunable dyes. Among the elements detected 9 (As, Au, In, Mn, Pb, Sb, Tl, W, Yb) show detection limits which are superior to those reported in the literature for LEI. The lowest detection limit obtained in this investigation was 1 pg/mL for In. Four of the elements (As, Sb, Yb, W) are reported as being detected by LEI for the first time. The multielement capabilities of LEI as a method for trace element analysis are discussed. (Author's abstract)
W87-07140

UV-EXTINCTIONS OF AQUATIC HUMIC ACIDS: ITS DEPENDENCE ON THE ELEMENTAL COMPOSITION,
Gesamthochschule Essen (Germany, F.R.). Inst. fuer Physikalische und Theoretische Chemie.
G. Peschel, and T. Wildt.
Fresnius' fuer Analytische Chemie ZACFAU, Vol. 325, No. 8, p 691-692, December 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Spectral analysis, *Analytical methods, *Humic acids, *Spectroscopy, *Chemical composition, Ruhr River, Molecular structure, Dissolved organic carbon.

Humic acids are the product of a natural heteropolycondensation of proteins, carbohydrates, fatty acids, lignins, and many other materials. Their multifunctional molecules show strong absorptions in the UV/VIS region. This property is used for the determination of humic acid contents of natural waters, which very often exceeds 50% of the dissolved organic carbon (DOC). The composition of aquatic humic acids changes rapidly within a few months. Therefore the influence of the elemental composition, expressed by the ratio H% / C% on the UV extinction of isolated aquatic humic acids from various origins was examined (River Ruhr at Essen-Steele (June to August 1984), effluents of wastewater plants, and water from the surface water of a peat bog near Meschede). The results showed a good linear correlation between 1/epsilon to the 280 and power H/C, the correlation coefficient being 0.951. (Airone-PTT)
W87-07144

METHANE-DERIVED AUTHIGENIC CARBONATES FORMED BY SUBDUCTION-INDUCED PORE-WATER EXPULSION ALONG THE OREGON/WASHINGTON MARGIN,
Lehigh Univ., Bethlehem, PA. Dept. of Geological Sciences.
S. Ritger, B. Carson, and E. Suess.
Geological Society of America Bulletin BUGMA, Vol. 98, No. 2, p 147-156, February 1987. 10 fig, 56 ref, append.

Descriptors: *Carbonates, *Interstitial water, *Methane, *Accretion, *Continental margin, Calcium carbonate, Oregon, Washington, Bacteria, Sedimentary structures, Chemical precipitation, Lithification, Minerals, Sediment-water interfaces.

Authigenic magnesian calcite, dolomite, and aragonite are precipitated in the uppermost terrigenous sediments of the Washington/Oregon accretionary prism by subduction-induced dewatering. These distinctive carbonates are methane-derived and occur at sites of concentrated pore-water expulsion. Unique biologic communities that subsist at least indirectly on methane are also found at some of these sites. The methane, which is dominantly biogenic, is carried to the uppermost sediments of the prism by fluids and is oxidized by sulfate reducers before being incorporated into a carbonate cement. Carbonate precipitation occurs below the oxic layer, probably no deeper than several centimeters to a few meters below the sea bed. Cementation may be induced by (1) increased carbonate alkalinity resulting from microbial sulfate reduction, (2) decreased sigma CO2 solubility caused by pressure decrease when the pore water escapes the prism, and/or (3) addition of Ca(2+) and Mg(2+) ions from sea water near the sediment-water interface. The convergent margin setting engenders precipitation of authigenic carbonates in several ways. Compressive stresses induce anomalously rapid compaction and dewatering rates, and they may cause overpressuring in migrating pore water, thus delaying precipitation of carbonates until pressure is released near the sediment water interface. Structural deformation of the accretionary prism creates pathways (such as fault zones), secondary fracture porosity, and dipping permeable layers (often exposed by mass movement) for efficient advection and expulsion of methane-enriched pore water. These characteristic conditions, which lead to the precipitation of methane-derived carbonates, may be found at other convergent margins. (Authors' abstract)
W87-07157

RELATIVE PRECIPITATION RATES OF ARAGONITE AND MG CALCITE FROM SEAWATER: TEMPERATURE OR CARBONATE ION CONTROL,
Washington Univ., St. Louis, MO. Dept. of Earth and Planetary Sciences.
E. A. Burton, and L. M. Walter.
Geology GLGYB, Vol. 15, No. 2, p 111-114, February 1987. 3 fig, 1 tab, 31 ref. NSF Grant EAR-8407535.

Descriptors: *Carbonates, *Calcite, *Chemical precipitation, *Temperature effects, *Aragonite, Kinetics, Oceans, Paleoclimatology, Mari sediments.

The temperature and degree of carbonate mineral supersaturation (CO3 (2-) ion concentration) of seawater are the two most likely controlling variables on the compositions of recent marine carbonate cements. The relative importance of these variables is difficult to assess in nature because they have similar trends with depth (0-1500 m) and latitude in modern oceans. Laboratory experiments were carried out to investigate the relative growth rates of calcite, Mg calcite, and aragonite in seawater as functions of both temperature (5, 25, and 37 C) and of carbonate ion concentration (2.5 to 15 times supersaturated with respect to calcite). Precipitation rates of aragonite relative to those of calcite increase strongly with increasing temperature and are not affected greatly by changes in saturation state. At 5 C, calcite precipitation rates are nearly equivalent to those of aragonite, regardless of the degree of saturation. At both 25 and 37 C, aragonite precipitation rates are much more rapid than those of calcite (up to a factor of 4), except at very low saturation states. Calcite compositions vary from less than 5 mol% MgCO3 at 5 C to 14 mol% MgCO3 at 37 C. The results suggest that the well-documented shift toward precipitation of lower mol% Mg calcite and the decrease in abundance of aragonite cements with increasing oceanic depth and latitude can be attributed largely to lower temperatures. Because temperature is important in controlling carbonate mineralogies in modern oceans, compositional variations of recent carbonate cements cannot be used as a base line against which to calibrate ancient oceanic carbonate ion levels or P(CO2) values. (Author's abstract)
W87-07160

FLUORESCENCE DETECTION OF SOME NITROSOAMINES IN HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AFTER POST-COLUMN REACTION,
Kyungpook National Univ., Taegu (Republic of Korea). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-07163

HIGHLY SELECTIVE DETERMINATION OF TRACE AMOUNTS OF COPPER(II), NICKEL(II) AND VANADIUM(V) IONS WITH TETRADENTATE SCHIFF-BASE LIGANDS BY REVERSED PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AND SPECTROPHOTOMETRIC DETECTION,
Tohoku Univ., Sendai (Japan). Dept. of Applied Chemistry.
For primary bibliographic entry see Field 5A.
W87-07164

CALCIUM CARBONATE PRECIPITATION AND TURBIDITY MEASUREMENTS IN OTISCO LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 2H.
W87-07182

INFLUENCE OF INFREQUENT FLOODS ON THE TRACE METAL COMPOSITION OF ESTUARINE SEDIMENTS,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 2J.
W87-07212

COMPARISON OF TWO METHODS FOR DETERMINING COPPER PARTITIONING IN OXIDIZED SEDIMENTS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W87-07215

13C NMR SPECTRA AND CU(II) FORMATION CONSTANTS FOR HUMIC ACIDS FROM FLUVIAL, ESTUARINE AND MARINE SEDIMENTS,
Florida Inst. of Tech., Melbourne.
M. Sohn, and D. Weese.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 61-72, October 1986. 6 fig, 2 tab, 24 ref.

Descriptors: *Humic acids, *Marine sediments, *Copper, *Nuclear magnetic resonance, Complex-

es, Carbon, Spectral analysis, Sediments, Organic matter, Florida.

Humic acids extracted from fluvial, estuarine and marine sediments from the eastern coast of Florida were studied by CP/MAS (cross-polarization/ magic angle spinning) 13C nuclear magnetic resonance. The freshwater humic acid contained a large percentage of lignin-derived aromatic carbon whereas the offshore marine samples contained large amounts of aliphatic carbon. The aliphatic carbon of the marine humic acids was more highly branched than that found for freshwater and estuarine sediments. Despite significant differences in the relative amounts and types of carbon present, conditional formation constants for Cu(II)-humic acid were very similar. (Author's abstract)
W87-07216

DETERMINATION OF ALKALINITIES OF ESTUARINE WATERS BY A TWO-POINT POTENTIOMETRIC TITRATION,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W87-07220

PREDICTING IONIC STRENGTH FROM SPECIFIC CONDUCTANCE IN AQUEOUS SOIL SOLUTIONS,
Punjab Agricultural Univ., Ludhiana (India).
N. S. Pasricha.
Soil Science SOSCAK, Vol. 143, No. 2, p 92-96, February 1987. 1 fig, 3 tab, 12 ref.

Descriptors: *Ionic strength, *Specific conductivity, *Soil solution, *Soil types, Prediction, Ions, Salts.

For predicting ionic strength from specific conductance, a saline soil, an alkali soil, and a normal typical rice soil amended with different levels of salt (NaCl) and alkali (NaHCO3) were kept submerged with deionized water for 12 wk. Despite wide variations in the ionic composition and ionic strength of the soil solutions, a close relationship (r = 0.98) was found between the actual ionic strength (total concentrations corrected for the presence of ion pairs) and specific conductance of equilibrium soil solutions collected by gravity every other week up to 12 wk. The ionic strength (moles/L) was approximately 11.62 times the specific conductance (mhos/cm, 25C). Higher values were found for ionic strengths measured from stoichiometric concentrations compared with values of actual ionic strengths measured after incorporating the corrections due to the presence of ion pairs. The variations were more in NaHCO3-amended soil (25 to 51%) than when the same soil was amended with NaCl (3 to 32%). Very good agreement was found between the ionic activities calculated from actual ionic strength and ionic strength predicted from specific conductance. (Author's abstract)
W87-07222

ABIOTIC CHEMICAL CHANGES IN WATER,
Bayer A.G., Wuppertal (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-07235

VARIATIONS OF 15N NATURAL ABUNDANCE OF SUSPENDED ORGANIC MATTER IN SHALLOW OCEANIC WATERS,
Tokyo Univ. (Japan). Ocean Research Inst.
T. Saino, and A. Hattori.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 1-13, 7 fig, 19 ref.

Descriptors: *Isotope studies, *Nitrogen compounds, *Organic matter, *Suspended load, *Path of pollutants, Ammonium, Euphotic zone, Nitrites, Nitrogen bacteria.

Natural abundances of 15-N in suspended particulate organic nitrogen (PON) were determined at 5 or 10 m intervals in the shallow layer at a station in the northwestern North Pacific (45 N, 160 E) in summer. An ammonium maximum was observed in the bottom of the euphotic layer, and a nitrite maximum appeared below the ammonium maximum layer. The 15-N natural abundance of suspended PON exhibited a minimum of -1.5/mil at slightly above the ammonium maximum, and then increased with depth to 4.8 per mil at 80 m. In the euphotic layer, suspended PON is enriched in 15-N. Variation in the natural abundance of 15-N in suspended PON is interpreted in terms of nitrogen cycling processes. It is inferred that during PON decay, the isotope fractionation in deamination, followed by the uptake of 15-N enriched ammonium (produced by ammonium oxidizing bacteria) by the nitrifiers and other bacteria is the primary cause of 15-N enrichment in PON. (See W87-07371) (Author's abstract)
W87-07372

CLUES TO THE STRUCTURE OF MARINE ORGANIC MATERIAL FROM THE STUDY OF PHYSICAL PROPERTIES OF SURFACE FILMS,
Naval Research Lab., Washington, DC. Chemistry Div.
W. R. Barger, and J. C. Means.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 47-67, 6 fig, 6 tab, 25 ref.

Descriptors: *Chemical analysis, *Marine environment, *Organic matter, *Physical analysis, *Surface films, *Chesapeake Bay, Organic films, Compressibility, Fatty acids, Triglycerides, Organic compounds.

Naturally occurring surface-active organic films reduce the surface tension of water samples. Films adsorbed on the surface of water collected from 16 Atlantic and 8 Chesapeake Bay stations were studied in detail. Film pressure vs. area characteristics were determined. A modified van der Waals type equation that describes the data when the films are modeled as two-dimensional gases suggests an effective size range for the molecules that make up the films. The model enables the number of moles of film-forming material in each sample and the molecular weight of this material to be estimated. Amounts on the surface of 450 ml water samples ranged from 14 times 10 to the -10th power to 119 times 10 to the -10th power moles. Molecular weights ranged from 1,400 to 4,900. Coefficients of compressibility were also determibed. An average value of 0.054 + or - 0.009 cm/dyne was found. Chemical analyses of surface microlayer films have often found fatty acids, triglycerides, or other monolayer-forming compounds. However, when our physical data for natural films are compared to data for films of a series of pure compounds, the general results indicate that natural films are not composed primarily of free fatty acids, alcohols, or hydrocarbons. More oxygenated molecules of higher molecular weight are indicated. (See also W87-07371) (Author's abstract)
W87-07374

REMOVAL OF TRACE METALS IN THE VERY LOW SALINITY REGION OF THE TAMAR ESTUARY, ENGLAND,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W87-07467

PEAT AND PEAT WATER CHEMISTRY OF A FLOOD-PLAIN FEN IN BROADLAND, NORFOLK, U.K.,
Sheffield Univ. (England). Dept. of Botany.
K. E. Giller, and B. D. Wheeler.
Freshwater Biology FWBLAB, Vol. 16, No. 1, p 99-114, February 1986. 8 fig, 3 tab, 38 ref.

Descriptors: *Water chemistry, *Peat, *Fens, *Flood plains, England, Brackish water, Ions, Nutrients, Seasonal variation.

Dominant chemical gradients in the peats of a flood-plain fen in Broadland, Norfolk were poor-fen (oligotrophic) rich-fen (minerotrophic) and freshwater brackish water. These gradients were to some extent obscured by a complex of factors governing the concentrations of ions in the peats and peat waters. The peats were almost totally organic and cation exchange capacities (CEC) varied with their macrofossil composition. Cladium mariscus L. peats had higher CEC than Phragmites communis Trin. peats of similar bulk density. Amounts of dissolved and extractable N and P were very low, but total amounts of N and P were high and closely related to bulk density. Large seasonal variation in concentrations of ions in the peat waters was due to dilution at times of flooding. There was strong evidence that little river water penetrated directly across the study area, contrary to classical descriptions of floodplain mires. Amplitude of fluctuations in concentration varied between study sites although the pattern of change was similar. Fluctuations were small in poor-fen, Sphagnum dominated sites. An incursion of brackish water up river due to unusually high tides was observed, but it is likely that brackish conditions in the fens are caused by release of ions from underlying estuarine clays. (Author's abstract)
W87-07488

LAGRANGIAN MODEL OF NITROGEN KINETICS IN THE CHATTAHOOCHEE RIVER,
Geological Survey, Richmond, VA. Water Resources Div.
H. E. Jobson.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 223-242, April 1987. 8 fig, 12 ref.

Descriptors: *Model studies, *Nitrogen kinetics, *Lagrangian models, *Chattahoochee River, Convection, Dispersion, Rivers, Kinetics, Nitrogen, Calibrations, Data interpretation.

A Lagrangian reference frame is used to solve the convection-dispersion equation and interpret water-quality data obtained from the Chattahoochee River. The model was calibrated using unsteady concentrations of organic nitrogen, ammonia, and nitrite plus nitrate obtained during June 1977 and verified using data obtained during August 1976. Reaction kinetics of the cascade type are shown to provide a reasonable description of the nitrogen-species processes in the Chattahoochee River. The conceptual model is easy to visualize in the physical sense and the output includes information that is not easily determined from an Eulerian approach, but which is very helpful in model calibration and data interpretation. For example, the model output allows one to determine which data are of most value in model calibration or verification. (Author's abstract)
W87-07491

SIMULTANEOUS EXTRACTION OF TRIVALENT AND PENTAVALENT ANTIMONY AND ARSENIC SPECIES IN NATURAL WATERS FOR NEUTRON ACTIVATION ANALYSIS,
Idaho Univ., Moscow. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-07534

DIRECT DETERMINATION OF ARSENITE BY DIFFERENTIAL PULSE POLAROGRAPHY IN THE PRESENCE OF LEAD(II) AND THALLIUM(I),
Alaska Univ., Fairbanks. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-07535

FLUOROMETRIC DETERMINATION OF HYDROGEN PEROXIDE IN GROUNDWATER,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5A.
W87-07536

SPECIFICITY OF THE ION EXCHANGE/ ATOMIC ABSORPTION METHOD FOR FREE COPPER(II) SPECIES DETERMINATION IN NATURAL WATERS,
Alberta Univ., Edmonton. Dept. of Chemistry.

For primary bibliographic entry see Field 5A.
W87-07537

COMPREHENSIVE TRACE LEVEL DETERMINATION OF ORGANOTIN COMPOUNDS IN ENVIRONMENTAL SAMPLES USING HIGH-RESOLUTION GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION,
Station Federale de Recherches en Arboriculture, Viticulture et Horticulture de Waedenswil (Switzerland).
For primary bibliographic entry see Field 5A.
W87-07538

FLUORIMETRIC DIFFERENTIAL-KINETIC DETERMINATION OF SILICATE AND PHOSPHATE IN WATERS BY FLOW-INJECTION ANALYSIS,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 7B.
W87-07569

2L. Estuaries

SHORT-TERM VARIABILITY IN BIOGENIC SULPHUR EMISSIONS FROM A FLORIDA SPARTINA ALTERNIFLORA MARSH,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 5B.
W87-06740

TIDAL AND TIDALLY AVERAGED CIRCULATION CHARACTERISTICS OF SUISUN BAY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
L. H. Smith, and R. T. Cheng.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 143-155, January 1987. 12 fig, 19 ref.

Descriptors: *Model studies, *Tidal currents, *Suisun Bay, *Salt transport, *Hydrodynamics, Calibrations, California, Mathematical equations, Equations, Tides, Water currents, Simulation, Velocity, Winds.

Availability of extensive field data permitted realistic calibration and validation of a hydrodynamic model of tidal circulation and salt transport for Suisun Bay, California. Suisun Bay is a partially mixed embayment of northern San Francisco Bay located just seaward of the Sacramento-San Joaquin Delta. The model employs a variant of an alternating direction implicit finite-difference method to solve the hydrodynamic equations and an Eulerian-Lagrangian method to solve the salt transport equation. An upwind formulation of the advective acceleration terms of the momentum equations was employed to avoid oscillations in the tidally averaged velocity field produced by central spatial differencing of these terms. Simulation results of tidal circulation and salt transport demonstrate that tides and the complex bathymetry determine the patterns of tidal velocities and that net changes in the salinity distribution over a few tidal cycles are small despite large changes during each tidal cycle. Computations of tidally averaged circulation suggest that baroclinic and wind effects are important influences on tidally averaged circulation during low freshwater-inflow conditions. Exclusion of baroclinic effects would lead to overestimation of freshwater inflow by several hundred cu m/s for a fixed set of model boundary conditions. Likewise, exclusion of wind would cause an underestimation of flux rates between shoals and channels by 70-100%. (Author's abstract)
W87-06825

ELEMENTS OF MARINE ECOLOGY: AN INTRODUCTORY COURSE,
Polytechnic of Central London (England).
R. V. Fait.
Butterworths, London, England. 1983. 356 p.

Descriptors: *Marine environment, *Marine ecology, *Ecology, *Marine biology, Ecosystems, Environmental effects, Marine resources.

Marine ecology is presented as a coherent science. Its scope derives from the original, broad definition of ecology as the study of organisms in relation to their surroundings. The purpose is to provide a foundation of knowledge for gaining some understanding of the structure and functioning of marine ecosystems rather than to study human involvements as the main objective. The impact of man on the marine environment and the problems of management of marine resources for human use are discussed only so far as is judged appropriate to preserve a sensible balance in a book which ranges widely over the sciences of the sea. The text has been compiled as introductory reading for students undertaking courses in marine biology. It provides information and ideas over the general field of marine ecology with reading lists from which more advanced information can be sought. Although designed mainly for undergraduates, its use in biology courses in schools has been kept in mind by adhering to simple terminology which should present no obstacle to science students. (Lantz-PTT)
W87-06847

COMPUTERIZED ASSESSMENT OF ENVIRONMENTAL IMPACTS IN AN ESTUARINE SYSTEM,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 6G.
W87-06941

STATISTICAL METHODOLOGY FOR PREDICTING SALINITY IN UPPER LAVACA BAY,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-07002

RELATIONSHIPS OF SALT-MARSH PLANT DISTRIBUTIONS TO TIDAL LEVELS IN CONNECTICUT, USA,
Connecticut Univ., Storrs. Ecology Section.
M. W. Lefor, W. C. Kennard, and D. L. Civco.
Environmental Management EMNGDC, Vol. 11, No. 1, p 61-68, January 1987. 4 fig, 5 tab, 14 ref.

Descriptors: *Species composition, *Salt marsh vegetation, *Tidal effects, *Tidal marshes, *Connecticut, Tidal amplitude, Statistical analysis.

A three-year study of Connecticut, USA, salt-marsh vegetation was undertaken to determine the relationship of its distribution on the marsh surface to tidal levels, particularly mean high water (MHW) as measured on each of three sites representing different tidal amplitudes. Elevations and species present were measured on 1-2m grids in 10 x 70-m belt transects at each site. After the data were subjected to discriminant analysis and other standard statistical procedures, the results showed that 98.4% of all observations of Spartina alterniflora Loisel, occurred at or below MHW. The data can aid in salt-marsh restoration by offering a reliable indicator of what species should be planted when restored elevations and on-site MHW are known. (Author's abstract)
W87-07085

ESTIMATING FRESHWATER INFLOW NEEDS FOR TEXAS ESTUARIES BY MATHEMATICAL PROGRAMMING,
Texas Water Development Board, Austin.
Q. M. Martin.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 230-238, February 1987. 4 fig, 26 ref.

Descriptors: *Estuaries, *Freshwater inflow, *Mathematical models, *Systems analysis, *Computer models, Evaluation, Estuarine environment, Mathematical studies, Mathematical equations, Bays, Texas, Estimating equations, Estimates, Seasonal variation, Environmental effects, Salinity, Linear programming, Nonlinear programming, Computer programs, Management planning, Fish harvest, Ecosystems.

As mandated by the Texas State Legislature, the Texas Department of Water Resources conducted studies of the effect of freshwater inflows on the bays and estuaries of Texas. Developed as part of these studies, a mathematical programming model is described for computing estimates of the monthly and seasonal freshwater inflows necessary to meet specified environmental conditions in each of the major estuaries of the Texas Gulf Coast. The optimization model relates freshwater inflow to the key estuarine indicators of salinity, marsh inundation, and commercial fisheries harvests. Three management proposals are formulated for each estuary, corresponding to ecosystem subsistence, maintenance of fisheries harvests, and fisheries harvest enhancement. Linear and nonlinear mathematical programming techniques are used to determine the optimal flows for each of these management alternatives in all but one of the seven major estuaries, where only one of the management proposals could be solved. (Author's abstract)
W87-07104

BRINGING UP OYSTERS,
For primary bibliographic entry see Field 2H.
W87-07134

EFFECTS OF LEVEE EXTENSION ON MARSH FLOODING,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
F. C. Wang.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 161-176, March 1987. 9 fig, 5 tab, 20 ref.

Descriptors: *Coastal marshes, *Levee extension, *Marsh flooding, *Flood protection, *Levees, *Flooding, *Louisiana, *Model studies, Hydrodynamics, Hydrology, Watersheds, Prediction, Sediments, Simulation,

Western Terrebonne Parish, a low-lying coastal marsh with numerous meandering bayous and small lakes, is located in south-central Louisiana. The area is frequently inundated by backwater, tidal, and headwater floodings. An extension of the existing Avoca Island levee is proposed for further providing flood protection to the area. This paper evaluates the potential changes in the hydrologic regime and the area's hydrodynamics caused by the proposed levee extension. The study area is modeled as a network of junctions and channels. Riverine and tidal boundary conditions are used as input to a watershed model that predicts the time history of water level, flow, and sediment of the area. The response of the marsh to flooding events is simulated with both existing and future conditions. The results in terms of surface water contours, current discharge patterns, and sediment concentration distributions are presented. The changes before and after the levee extension are discussed. (Author's abstract)
W87-07192

GREENHOUSE EFFECT, SEA LEVEL RISE, AND COASTAL DRAINAGE SYSTEMS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-07196

COMPARISON OF TWO METHODS FOR DETERMINING COPPER PARTITIONING IN OXIDIZED SEDIMENTS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W87-07215

ANNOTATED NITROGEN BUDGET CALCULATION FOR THE NORTHERN ADRIATIC SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
D. Degobbis, M. Gilmartin, and N. Revelante.
Marine Chemistry MRCHBD, Vol. 20, No. 2, p 159-177, November 1986. 1 fig, 6 tab, 73 ref. NSF

Grants GF31947X, GA3127X and F7F022Y.

Descriptors: *Nitrogen budget, *Adriatic Sea, *Limnology, Denitrification, Wastewater, Sediments, Mass transport, Nutrients, Recycling, Primary production.

The nitrogen budget of the northern Adriatic, one of the most productive subregions in the Mediterranean area, was estimated from data sets collected since 1966 and from results reported in the literature. River, wastewater and atmospheric contributions, water mass exchange, losses by sedimentation and in fish catches accounted for the major nitrogen inputs and outputs of the investigated area. The calculated nitrogen inputs (17,320,000,000 mol/y) were significantly higher than the outputs (11,870,000,000 mol/y). Nitrogen losses by denitrification in sediments can account for the major part of this difference. The results highlight the relative importance of the nitrogen contribution by the Po River (50% of the input) whose waters influence a large part of the northern Adriatic, and the loss by water mass transport, as the principal mechanisms balancing the nitrogen budget in the northern Adriatic. A quantity about twice the yearly input is biologically recycled annually in the northern Adriatic. Calculated assimilation and regeneration rates show a difference of about 40%, which can be ascribed to uncertainties in some of the data used, particularly the possible underestimation of the primary production measured by the 14C uptake method. (Author's abstract)
W87-07219

POPULATION DYNAMICS AND SECONDARY PRODUCTION IN AN ESTUARINE POPULATION OF NEPHTYS HOMBERGII (POLYCHAETA: NEPHTYIDAE),
Southampton Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5E.
W87-07226

RECURRENT AND CHANGING SEASONAL PATTERNS IN PHYTOPLANKTON OF THE WESTERNMOST INLET OF THE DUTCH WADDEN SEA FROM 1969 TO 1985,
Nederlands Inst. voor Onderzoek der Zee, Texel.
G. C. Cadee.
Marine Biology MBIOAJ, Vol. 93, No. 2, p 281-289, November 1986. 5 fig, 2 tab, 48 ref.

Descriptors: *Species composition, *Phytoplankton, *Wadden Sea, *Seasonal variation, *Limnology, Algae, Diatoms, Turbidity, Flagellates.

Data for phytoplankton composition and abundance in the Marsdiep are presented for the period from 1969 to 1985 inclusive. Only a few species dominated the phytoplankton. A recurrent pattern was observed in the seasonal succession: in winter, total cell numbers were invariably low, but freshwater algae, sluiced into the Wadden Sea from IJssel Lake, showed highest densities in winter. A diatom spring peak was observed around mid-April, followed by a Phaeocystis pouchetii peak about three weeks later. Later in summer usually two more diatom peaks followed by non-diatom peaks were present. The exact timing of the spring peak varied from year to year, with extremes being late March and early May. A relatively late spring peak usually coincided with a relatively high turbidity in the preceding winter. An increase in total cell numbers was found over the 17-year observation period. Diatoms decreased form 1969 to 1974 but have increased since then, reaching values above those of 1969 during recent years. Flagellates showed a consistent increase over the entire observation period. (Author's abstract)
W87-07227

UTILIZATION OF GROWTH PARAMETERS OF EELGRASS, ZOSTERA MARINA, FOR PRODUCTIVITY ESTIMATION UNDER LABORATORY AND IN SITU CONDITIONS,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 2I.
W87-07228

MECHANISMS OF PRODUCTION AND FATE OF ORGANIC PHOSPHORUS IN THE NORTHERN ADRIATIC SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
I. Ivancic, and D. Degobbis.
Marine Biology MBIOAJ, Vol. 94, No. 1, p 117-125, February 1987. 7 fig, 2 tab, 29 ref.

Descriptors: *Primary productivity, *Adriatic Sea, *Limnology, *Phosphorus, Nutrients, Chlorophyll a, Po River, Phytoplankton, Organic matter, Seasonal variation, Salinity.

In the period from 1980 to 1984 organic phosphorus, nutrients, primary production rates (14C), chlorophyll a (chl a) standing crops, and basic oceanographic parameters were measured during 23 cruises at six stations in the open waters of the northern Adriatic Sea. These waters are significantly influenced by polluted Po River discharge. Organic phosphorus was correlated with several parameters which characterize phytoplankton activity and organic matter decomposition processes. In the late winter-spring period, organic phosphorus is produced during phytoplankton blooms. It is hypothesized that microzooplankton grazing is the main factor increasing the organic phosphorus concentrations in summer (up to 1.1 micromol/L). Fall and winter had much lower values (below 0.3 micromol/L), due to remineralization processes and an increased water mass exchange between the northern and central Adriatic regions. The direct contribution of organic phosphorus by freshwater discharge was not found to be significant. The higher organic phosphorus concentrations that can occur in low salinity waters are most likely due to their increased capability to support primary productions. (Author's abstract)
W87-07231

NUTRIENT REGENERATION IN SHALLOW-WATER SEDIMENTS OF THE ESTUARINE PLUME REGION OF THE NEARSHORE GEORGIA BIGHT, USA,
Georgia Univ., Sapelo Island. Marine Inst.
C. S. Hopkinson.
Marine Biology MBIOAJ, Vol. 94, No. 1, p 127-142, February 1987. 13 fig, 3 tab, 68 ref.

Descriptors: *Cycling nutrients, *Marine sediments, *Estuaries, *Georgia Bight, *Limnology, *Model studies, Nutrients, Sediments, Respiration, Nitrogen, Phosphorus, Ammonium.

Benthic community respiration and the cycling of N and P were seasonally investigated in the unprotected, sandy sediments (Z 5m) of the nearshore zone of the Georgia Bight, USA in 1981 and 1982. Nutrient exchange across the sediment-water interface was calculated from a diffusive model, measured by in-situ enclosure experiments and estimated from whole core incubations. Seasonally changing pore water profiles indicated that the sediments were not in steady-state with respect to N and P and showed the characteristics of enhanced interstitial water movement by benthic animals. Over an annual period the total flux of nitrogen measured in situ averaged 1812 micromol(umol)/sq m/d from the sediments. NH4(+) flux accounted for the vast majority of the total directly measured N flux (77%), followed by nitrate + nitrite (14%), and dissolved organic nitrogen (9%). Phosphorus flux averaged 537 umol/sq m/d. A large ratio of in-situ fluxes to calculated diffusive fluxes (5.2:1) indicated flux enhancement due to benthic animal activity. Ammonium fluxes measured in situ did not agree well with the rate of NH4(+) produced in incubated whole cores (11.7 mmol/sq m/d). Relative rates of C, N and P release throughout the year fluctuated considerably. Generally, nutrient fluxes were not simply related to respiration or temperature. As respiration was highly correlated with temperature, however, this suggested that respiration-regeneration was temporarily decoupled from exchange across the sediment-water interface. The annual C-N-P flux stoichiometry was 130:3.1:1. Using the rate at which NH4(+) was produced in incubated cores the stoichiometry was 120:21:1. The anomalously low N flux measured in situ was attributed to a combination of denitrification and wave- and current-induced sediment nutrient flushing. The potential for sediment flushing is high as experiments showed that sediments were fluidized or resuspended down to 25 cm during large storms. Benthic nutrient flux contributed 40% to the annual P but only 11% to the annual N requirements of the pelagic primary producers. (Author's abstract)
W87-07232

COLUMBIA RIVER ESTUARY DATA DEVELOPMENT PROGRAM (CREDDP). DYNAMICS OF THE COLUMBIA RIVER ESTUARINE ECOSYSTEM. VOLUME 2,
Columbia River Estuary Study Taskforce, Astoria, OR.
C. Simenstad, D. Jay, C. D. McIntire, W. Nehlsen, and C. Sherwood.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-244482. Price codes: A16 in paper, and A01 in microfiche. June 1984. 352 p, 79 fig, 64 tab, 296 ref.

Descriptors: *Columbia River, *Estuaries, *Estuarine environment, *Ecosystems, Dynamics, Tides, Mixing, Sediments, Detritus, Turbidity.

The Columbia River Estuary ecosystem is energetic and highly variable in both time and space. Circulation processes are driven by energy inputs from riverflow and the tides; the tidal energy is the dominant factor below Tongue Point. The variable energy input and non-linear interaction between topography, flow, mixing, and stratification produces a complex and variable circulation. Despite these complexities, circulation, sedimentation, and biological data all indicate that the system can be divided into three zones: tidal-fluvial, estuarine mixing, and plume and ocean. Because of the high energy level, very little fine sediment is permanently retained within the system. Fine sediments and detritus are, however, temporarily retained in the region of the turbidity maximum and peripheral bays. These accumulation zones have much longer residence times than the estuary as a whole. As a result of the energetic nature of the estuary, biological structure and processes are affected and limited more by the physical environment than by the ecological processes which structure less-energetic systems. In particular, the turbidity maximum appears to be a focal region of detritus accumulation and consumer production. Although the geological history of the system is not well understood, it appears that riverflow regulation, shoreline development, and modifications for navigation have had the effects of reducing the tidal prism, altering circulation patterns, removing productive peripheral habitats, reducing and stabilizing riverflow, and increasing the sedimentation rate of fine sediments in the estuary. This sequence of events is qualitatively similar to that which has led to severe environmental degradation in less energetic estuaries. Therefore, future alterations of any component of the river-estuary-plume system should be based on thoughtful and systematic evaluation of long-term effects, a realization of the unity of the system, and a better understanding of the physical and biological processes and interactions than is available at the present time. (Lantz-PTT)
W87-07364

MARINE AND ESTUARINE GEOCHEMISTRY.
Geolcgical Survey, Reston, VA.
Lewis Publishers, Inc., Chelsea, Michigan. 1985. 331 p. Edited by A. C. Sigleo and A. Hattori.

Descriptors: *Estuaries, *Marine environment, *Ecosystems, *Geochemistry, *Path of pollutants, Organic compounds, Inorganic compounds, Fate of pollutants, Polychlorinated biphenyls, Silicon, Styrene, Organic matter.

As the world's terrestrial environments become further populated, marine and estuarine ecosystems are being increasingly impacted by anthropogenic activities, particularly by the disposal of waste products. To predict the effects of these activities, it is necessary to understand fundamental marine

and estuarine processes. Both directly and indirectly the chapters in this book address this issue, integrating concepts and analytical techniques from chemistry, biochemistry, geochemistry and oceanography. Topics in organic and inorganic geochemistry, as well as data on nutrient cycling, are represented. Studies of specific biogenic compounds are complemented by studies of the distributions and fate of anthropogenic PCBs (polychlorinated biphenyls), silicones and the pyrolyzate styrene. Many of the chapters emphasize the need for in-depth measurements over annual cycles to establish baseline biogenic inputs. Even in the deep sea, the flux of organic matter in the water column, and its composition, are subject to seasonal fluctuations of primary productivity in surface waters. Geographically, these chapters cover the Pacific, Atlantic and antarctic oceans, and major estuaries from Tokyo Bay and the Keum Estuary (Korea) in Asia to San Francisco Bay, Chesapeake Bay, and the St. Lawrence Estuary in North America. Studies include transport processes, and nutrient and metal distributions by depth as well as regionally. Nutrient cycling and the mass balance of essential elements such as carbon and nitrogen have been considered using a wide range of analytical methods and state-of-the-art sampling techniques. To determine the effects of anthropogenic activities on marine and estuarine environments, these processes must continue to be studied and adequately understood. (See also W87-07372 thru W87-07386) (Lantz-PTT)
W87-07371

STABLE ISOTOPE AND AMINO ACID COMPOSITION OF ESTUARINE DISSOLVED COLLOIDAL MATERIAL,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W87-07373

THERMAL DEGRADATION PRODUCTS OF NON-VOLATILE ORGANIC MATTER AS INDICATORS OF ANTHROPOGENIC INPUTS TO ESTUARINE AND COASTAL SEDIMENTS,
Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 5B.
W87-07376

BUDGETS AND RESIDENCE TIMES OF NUTRIENTS IN TOKYO BAY,
Geological Survey of Japan, Yatabe. Marine Geology Dept.
E. Matsumoto.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 127-136, 3 fig, 3 tab, 8 ref.

Descriptors: *Nutrients, *Tokyo Bay, *Japan, *Sediment transport, Cycling nutrients, Phosphorus, Nitrogen, Water column.

The total nutrient input to Tokyo Bay may be estimated as the sum of the output, which comprises sedimentation on the bay bottom, and outflow from the bay mouth. Element analyses were combined with Pb-210 dating to enable calculation of sedimentation rates of nutrients. Rates of nutrient outflow were determined from hydrological observation and element analyses. The residence time of nutrients were calculated to be 0.116 year for phosphorus and 0.123 year for nitrogen. The residence times of nutrients were close to the residence time of the bay water (0.129 year), suggesting that nutrients in the bay are rapidly recycled in the water column, and finally may be transported to the open ocean. (See also W87-07371) (Author's abstract)
W87-07379

SEASONAL AND INTERANNUAL NUTRIENT VARIABILITY IN NORTHERN SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA.
R. E. Smith, D. H. Peterson, S. W. Hager, D. D. Harmon, and L. E. Schemel.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 137-159, 9 fig, 3 tab, 68 ref.

Descriptors: *Seasonal variation, *Nutrients, *San Francisco Bay, *California, Phytoplankton, Cycling nutrients, Estuaries, Silica, Nitrates, Phosphates, Ammonium.

Information concerning the nature and causes of dissolved inorganic nutrient variability in estuaries on seasonal and inter-annual time scales is important to a variety of research efforts including studies of the effects of man and climate on estuarine biochemistry, global nutrients, and estuarine ecology. The nutrient distributions investigated are dissolved silica, nitrate, phosphate and ammonium in northern San Francisco Bay estuary. Two characteristic patterns in these distributions are considered. In particular, conservative or near-conservative distributions are associated with periods of high river flow whereas non-conservative distributions are associated with phytoplankton assimilation. During winter nutrient sources dominate the nutrient-salinity distribution patterns. During summer, however, the sources and sinks are in close competition. Summers of wet years have characteristics more like winter because sources often dominate the nutrient distributions whereas in summers of dry years sinks dominate. (See also W87-07371) (Author's abstract)
W87-07380

EFFECTS OF THE CLAY MINERAL, BENTONITE, ON ACETATE UPTAKE BY MARINE BACTERIA,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
W. B. Yoon, and R. A. Rosson.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 181-195, 4 fig, 3 tab, 28 ref.

Descriptors: *Estuaries, *Clays, *Bentonite, *Acetates, *Marine environment, *Bacteria, *Bacterial physiology, Turbidity, Suspended solids, Carbon radioisotopes, Hydrogen ion concentration, Bacterial analysis.

Shallow estuarine waters are frequently turbid due to wind-driven resuspension of surface sediments. Bacterial microheterotrophic uptake (Assimilation plus respiration of substrate) in the water column may be affected by resuspended inorganic particles like clay. Effects of clay (bentonite) on bacterial metabolism were studied with cultures of estuarine bacteria in various physiological states, and with samples of natural free-living bacteria, using trace levels of (1-14C) acetate as substrate. All bacteria tested metabolized acetate more efficiently in the presence of clay; either assimilation was increased without increasing respiration, or respiration decreased with little or no change in assimilation. No change in pH was measured during incubation and no adsorption of acetate by clay was detected. The data imply that physiochemical properties of bacterial surfaces may be responsible for the observed effects of clay on bacterial metabolism. (See also W87-07371) (Author's abstract)
W87-07381

SEDIMENTARY PROCESSES OF FINE SEDIMENTS AND THE BEHAVIOUR OF ASSOCIATED METALS IN THE KEUM ESTUARY, KOREA,
Seoul National Univ. (Republic of Korea). Dept. of Oceanography.
For primary bibliographic entry see Field 2J.
W87-07382

SPECIATION OF DISSOLVED SELENIUM IN THE UPPER ST. LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
K. Takayanagi, and D. Cossa.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 275-284, 6 fig, 21 ref.

Descriptors: *Selenium, *Estuaries, *St. Lawrence River, *Speciation, Selenite, Salinity, Inorganic compounds, Water sampling.

Water samples collected from the upper St. Lawrence Estuary were analyzed for selenite, dissolved inorganic selenium and dissolved total selenium (sigma-Se). The concentrations ranged from 0.25 to 1.71 nmole/kg for selenite, from 0.41 to 2.08 nmole/kg for inorganic Se and from 0.62 to 2.34 nmole/kg for sigma-Se over a salinity range of 0.05 to 31.2 parts per thousand. Selenite, inorganic Se and sigma-Se were found to behave conservatively at salinities above 0.2 parts per thousand, with the concentration of each species decreasing with increasing salinity. Selenate, calculated as the difference between inorganic Se and selenite, and organic Se, calculated as the difference between sigma-Se and inorganic Se, were also conservative, with no significant interconversion between selenium species observed in these salinity ranges. Although selenite appeared to be rapidly removed at salinities less than 0.2 parts per thousand, a corresponding decrease of inorganic Se or sigma-Se, or a corresponding increase of selenate was not observed in this salinity range. Selenite was the predominant species in the river endmember, while selenate, selenite and organic Se each shared significant fractions of the total selenium in the ocean endmember. (See also W87-07371) (Author's abstract)
W87-07384

SPARTINA ALTERNIFLORA LITTER IN SALT MARSH GEOCHEMISTRY,
Naval Research Lab., Washington, DC. Chemistry Div.
R. E. Pellenbarg.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 305-314, 3 fig, 3 tab, 14 ref.

Descriptors: *Salt marshes, *Geochemistry, *Spartina, Litter, Estuaries, Literature reviews, Iron, Zinc, Tidewater, Heavy metals, Marshes.

Abiotic interactions between Spartina alterniflora litter and the waters and sediments of a salt marsh are examined in this review paper. The litter is shown to be capable of scavenging the aqueous surface microlayer and associated trace metals from marsh tidal waters. Such litter-water interactions can lead to an eight-fold increase in litter zinc content in the short term. Litter sediment interchanges are affected by redox processes in the anoxic sediments of the marsh which seasonally releases dissolved, reduced iron. As the reduced iron is oxidized at the sediment surface, and retained in part as a coating on litter there, other metals such as copper and zinc are enriched in the litter by coprecipitation. (See also W87-07371) (Author's abstract)
W87-07385

DISTRIBUTION OF CHEMICAL ELEMENTS IN SELECTED MARINE ORGANISMS: COMPARATIVE BIOGEOCHEMICAL DATA,
Kyoto Univ. (Japan). Dept. of Chemistry.
T. Yamamoto, Y. Otsuka, K. Aoyama, H. Tabata, and K.-I. Okamoto.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 315-327, 2 fig, 8 tab, 29 ref.

Descriptors: *Marine plants, *Biochemistry, Marine environment, Algae, Angiosperms, Zooplankton, Phytoplankton, Iron, Aluminum, Seawater.

A systematic study of 44 elements in various Japanese seaweeds (245 samples) was carried out by chemical and neutron activation analyses. Marine phytoplankton, marine zooplankton and freshwater angiosperms were analyzed for comparative data. A method to compare multi-element data in many samples by the seawater concentration and ocean residence time of the element is proposed. The results of these calculations indicate that Japanese seaweeds have slightly higher contents of elements with long resident times (Fe and Al), whereas phytoplankton contain higher contents of elements with shorter residence times (Na and Mg). (See also W87-07371) (Author's abstract)
W87-07386

MICROBIAL COMMUNITIES IN SURFACE WATERS AT THE PUERTO RICO DUMPSITE,
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5E.
W87-07406

CARBON DIOXIDE SYSTEM IN ESTUARIES - AN INORGANIC PERSPECTIVE,
Marine Biological Association of the United Kingdom, Plymouth (England).
M. Whitfield, and D. R. Turner.
The Science of the Total Environment STENDL, Vol. 49, p 235-255, March 1986. 7 fig, 6 tab, 38 ref.

Descriptors: *Carbon dioxide, *Hydrogen ion concentration, *Estuaries, Alkalinity, Rivers, Seawater, Equilibrium, Advection.

The thermodynamics of the carbon dioxide system in estuarine waters has been re-assessed using the carbon dioxide solubility data of Weiss and the stability constants of Hansson and Mehrbach et al. as summarised by Millero. The end-members were assumed to be air-equilibrated with a pH of 8.2 at the seaward end and pH values of 7.0, 8.0 and 9.0 for the fresh-water end-members at 15 C. The influence of temperature on the calculated pH profiles was complex since the corresponding alterations in the ionization constants and in the solubility of carbon dioxide tend to have opposing effects on the pH. Differences as large as 0.7 pH units were noted between equilibrium pH profiles calculated for estuarine systems which were respectively closed and open to carbon dioxide exchange with the atmosphere. The mixing of river water and sea water therefore tends to produce significant disequilibrium between the estuary and the atmosphere which may manifest itself as a deficit or as an excess of carbon dioxide, depending on the pH and alkalinity of the river water. The influence of air-water exchange characteristics on the equilibration of estuarine water with the atmosphere was considered with the aid of an advective analogue of the Tamar Estuary (S.W. England). The calculations indicate that in a real estuary the pH and pCO2 profiles will lie between the characteristics of open and closed systems and are unlikely to approach equilibrium with the atmosphere. Chemical enhancement of carbon dioxide exchange had little effect on the degree of equilibration. (Author's abstract)
W87-07465

REMOVAL OF TRACE METALS IN THE VERY LOW SALINITY REGION OF THE TAMAR ESTUARY, ENGLAND,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris.
The Science of the Total Environment STENDL, Vol. 49, p 297-304, March 1986. 5 fig, 1 tab, 10 ref. Dept. of the Environment Contract PECD 7/7/076.

Descriptors: *Trace metals, *Salinity, *Turbidity, *Tamar Estuary, *Estuaries, *Model studies, *Sorption, Field tests, Prediction, Suspended matter.

Field observations have shown that the removal of a substantial proportion of the riverine influx of dissolved trace metals is a consistent feature of the very low salinity, high turbidity zone of the Tamar Estuary. Comparison of field data with the predictions of a simple sorptive equilibrium model indicates that the removal occurs through rapid uptake onto suspended particles comprising the estuarine turbidity maximum. The maintenance of relative depletion of exchangeable trace metals on this particle population is attributable to internal cycling of resuspendable particles within the estuary. (Author's abstract)
W87-07467

TIDAL BEHAVIOUR OF POST-LARVAL PENAEID PRAWNS (CRUSTACEA:DECAPODA:PENAEIDAE) IN A SOUTHEAST AFRICAN ESTUARY,
Natal Univ., durban (South Africa). Dept. of Biological Sciences.
A. T. Forbes, and M. C. Benfield.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 102, No. 1, p 23-34, November 1986. 5 fig, 6 tab, 23 ref.

Descriptors: *Limnology, *Crustaceans, *Tidal effects, *Shrimp, *Estuarine environment, *Migration, *Animal behavior, *Natal, Environment, Ecology, Behavior, Tides, Floods, Tidal floods, Distribution, Diurnal distribution, Vertical distribution, Survival, Salinity, Chemical properties.

The mechanisms by which the post-larvae of many species of inshore penaeid prawns migrate from the sea into estuarine habitats have not been adequately explained. Collections of penaeid post-larvae in the St. Lucia estuary in Natal, South Africa during flood and ebb tides, day and night, were found to be dominated by Penaeus japonicus and P. indicus. P. indicus was most abundant over flood tides, day and night, but P. japonicus was markedly more nocturnal and abundant only over night floods. Vertical distribution differed in the two species. P. japonicus was more abundant in bottom samples, but this was much less apparent in P. indicus. It is suggested that movement into the water column is triggered by pressure changes modified by light, salinity, and the nature of the substratum. These responses are discussed in relation to the invasion of estuaries by penaeid post-larvae and the apparent survival of P. indicus but not P. japonicus in the St. Lucia system. (Author's abstract)
W87-07550

ENVIRONMENTAL TOLERANCE OF THE ESTUARINE DIATOM MELOSIRA NUMMULOIDES (DILLW.) AG.,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
D. A. Rendall, and M. Wilkinson.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 102, No. 2/3, p 133-151, November 1986. 11 fig, 4 tab, 33 ref.

Descriptors: *Limnology, *Photosynthesis, *Estuarine environment, *Diatoms, *Melosira, *Algal growth, *Physiological ecology, *Clyde Estuary, *Salt tolerance, Environment, Marine biology, Algae, Salinity, Chemical properties, Growth, Ecology, Plant physiology, Density, Population density, Light intensity, Grazing, Estuaries.

The diatom Melosira nummuloides is abundant in the Upper Clyde estuary, which for years has suffered from severe sewage pollution causing frequent periods of deoxygenation with concomitant detrimental effects on the biota. A study was undertaken to investigate effects of the major physical environmental factors and their interactions on the distribution and abundance of the algae. Growth rate in culture of three isolates of Melosira from the estuary was found to be uniform over the salinity range 5-34‰, although there was no growth in freshwater medium (0.5‰). Plants maintained at 0.5‰ for up to eight days suspended growth, which was resumed on transfer back to higher salinity. The low light saturation point for growth (37 microE/sq m/s) would enable growth to occur at the low light intensity found in a turbid estuary. Large salinity fluctuations (5-23‰) had little effect on the net rate of photosynthesis. These features are adaptive to the estuarine environment, but it is concluded that they cannot alone explain the unusual abundance of this species in the Clyde Estuary. (Author's abstract)
W87-07552

TEMPERATURE DEPENDENCY OF CARBOHYDRASE ACTIVITY IN THE HEPATOPANCREAS OF THIRTEEN ESTUARINE AND COASTAL BIVALVE SPECIES FROM THE NORTH AMERICAN EAST COAST,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
V. Brock, V. S. Kennedy, and A. Brock.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 103, No. 1-3, p 87-101, December 1986. 8 fig, 3 tab, 25 ref.

Descriptors: *Limnology, *Temperature effects, *Estuarine environment, *Mollusks, *Eastern North America, *Enzymes, *Physiological ecology, Environment, Temperature, Water temperature, Substrates, Marine biology, Ecology, Animal physiology, Tissue analysis, Acidity, Hydrogen ion concentration, Chemical properties, Physical properties, Behavior, Food habits, Distribution, Spatial distribution, Annual distribution.

The enzymatic potential for hydrolyzing different carbohydrates at different temperatures is of importance for the energy supply of bivalves. The glycolytic potentials of three groups of carbohydrases from the hepatopancreas was studied, using 13 species from North American estuarine and coastal waters. The groups were alpha-amylase (1,4 alpha-D-glucan glucanohydrolase), cellulase (1,4 beta-D-glucan-4 glucanohydrolase), and laminarinase (1,3 beta-D-glucan-3 glucanohydrolase). The alpha-amylases exhibited optimal activity in the pH range 6-7.5, cellulases in the pH range 6-7, and laminarinases in the pH range 5.5-6.5. Enzymatic activity was studied in the temperature range 4-32 C. Results are discussed in relation to the species' mode of feeding, relation to substrates, geographical distribution, and annual patterns of food availability. (Author's abstracts)
W87-07553

INTERACTION BETWEEN NEREIS DIVERSICOLOR O. F. MULLER AND COROPHIUM VOLUTATOR PALLAS AS A STRUCTURING FORCE IN A SHALLOW BRACKISH SEDIMENT,
Lund Univ. (Sweden). Dept. of Animal Ecology.
E. B. Olafsson, and L.-E. Persson.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 103, No. 1-3, p 103-117, December 1986. 2 fig, 7 tab, 56 ref.

Descriptors: *Limnology, *Estuarine environment, *Nereis, *Corophium, *Polychaetes, *Bottom sediments, *Distribution patterns, *Ecology, *Amphipods, *Shallow water, Estuaries, Environment, Annelids, Sediments, Marine sediments, Marine biology, Ecological distribution, Crustaceans, Ecosystems, Sedimentation, Density, Population density, Predation, Coastal waters.

Distributional patterns of the polychaete Nereis diversicolor and the amphipod Corophium volutator were studied in an estuarine, shallow soft bottom on the south coast of Sweden. For two years, the study site was divided into a 'Corophium patch' with high densities of Corophium and low densities of Nereis and a 'Nereis patch' with high densities of Nereis and low densities of Corophium. In the third year, Corophium almost disappeared from the study site; this great reduction of Corophium densities was a general phenomenon in the coastal region around the study site. In the absence of Corophium, Nereis reached the same densities in the 'Corophium patch' as in the 'Nereis patch'. Laboratory experiments support the conclusion that high densities of Nereis reduce the density of Corophium, mainly through the effect of disturbance and not by predation. A survey of the literature indicates that Corophium may have a negative impact on recruiting Nereis. It is suggested that biotic interactions are the main factors preserving the observed patchiness at the study site, while accidents of history break up patchiness patterns. (Author's abstract)
W87-07554

EFFECTS OF EXTENDED PERIODS OF DRAINAGE AND SUBMERSION ON CONDITION AND MORTALITY OF BENTHIC ANIMALS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. Hummel, A. Meijboom, and L. de Wolf.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 103, No. 1-3, p 251-266, December 1986. 7 fig, 5 tab, 25 ref.

Descriptors: *Limnology, *Drainage, *Submergence, *Benthic fauna, *Mortality, *Ecology, *Estuarine environment, *Tidal effects, Aquatic animals, Benthos, Fauna, Marine biology, Environment, Estuaries, Netherlands, Tidal amplitude,

Tidal currents, Density, Population density, Polychaetes, Annelids, Gastropods, Mollusks, Distribution, Seasonal distribution, Survival, Salinity, Chemical properties.

Temporary closure of the storm-surge barrier in the Oosterschelde estuary (The Netherlands) affects the tidal amplitude and rates of tidal currents. The effects of tidal manipulation on the numbers and condition of intertidal benthic animals was assessed by exposing undisturbed sediment cores and isolated animals to prolonged drained conditions (ebb) or submerging them in stagnant water. Part of the drained sediment cores (rained cores) received a daily extra supply of simulated rain water. Permanent submersion did not affect the benthic animals. Most species suffered heavily from drainage, irrespective of an extra supply of tap water. The smaller animals without shells, such as anemones and small polychaetes, were the most susceptible to drainage, gastropods the least. The mortality rate was highest during the summer, somewhat lower in spring, and lowest in autumn and winter. The decrease in water content and the change in salinity in the sediment, as observed in the drained and rained sediment cores, did not contribute to the survival (or mortality) of the animals. At drainage, the ambient air-temperature and the glycogen content of the animals determined their mortality rate. High temperatures (25 to 30 C) and a low glycogen content increased the mortality rate. No decrease in the glycogen content of the animals during the stress periods was observed. (Author's abstract)
W87-07555

ZINC, COPPER AND NICKEL CONCENTRATIONS IN RYEGRASS GROWN ON SEWAGE SLUDGE-CONTAMINATED SOILS OF DIFFERENT PH,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 5E.
W87-07581

CENTRAL CALIFORNIA COASTAL CIRCULATION STUDY,
Oregon State Univ., Corvallis. Coll. of Oceanography.
D. B. Chelton, R. L. Bernstein, A. Bratkovich, and P. M. Kosro.
Eos EOSTA, Vol. 68, No. 1, p 1, 12-13, January 1987. 7 fig, 19 ref.

Descriptors: *Central California Coastal Circulation Study, *Continental shelf, *Continental slope, *Oceanography, *California, *Seasonal variation, *Water currents, *Data aquisition, Ecosystems, Ecological effects, Hydrography, Remote sensing, Current meters, Satellite technology, Data collections, Meteorologic data collection, Temperature, Weather, Wind, Flow.

Preliminary results of the Central California Coastal Circulation Study (CCCCS) are reported. This 18-month field program was designed by the Department of the Interior to study the variability of water mass characteristics and the velocity field on the continental shelf and upper continental slope of California from Port Conception to San Francisco. The data set includes densely sampled conductivity-temperature-depth (CTD) measurements, drifters, a nearly continuous 18-month time series of satellite images, current meter measurements, and buoy measurements of vector winds and sea surface temperature. Novel findings include a relatively consistent coastally trapped poleward flow over the shelf in the entire study region, the cause of which has not been identified. Areas that need further study include (1) the question of whether the circulation is truly more complex spatially (and perhaps temporally) in the region immediately north of Point Conception; (2) the discrepancy between drifter trajectories and geostrophic velocities during the two winter surveys; (3) major differences in water mass characteristics between the two winter surveys; and (4) the greater presence of fine scale structure (intrusions) in the water column in the fall. Data reports are expected to be completed by early 1987. (Doria-PTT)
W87-07587

CONTROL STRATEGIES FOR THE PROTECTION OF THE MARINE ENVIRONMENT,
Department of the Environment, Halifax (Nova Scotia). Office of the Regional Director General.
For primary bibliographic entry see Field 5G.
W87-07589

CONTROL OF MARINE POLLUTION GENERATED BY OFFSHORE OIL AND GAS EXPLORATION AND EXPLOITATION: THE SCOTIAN SHELF,
Braidwood, MacKenzie, Brewer and Greyell, Vancouver (British Columbia).
For primary bibliographic entry see Field 5G.
W87-07590

MODELLING OIL MOVEMENTS FROM THE KURDISTAN SPILL IN CABOT STRAIT, NOVA SCOTIA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 5B.
W87-07592

EARLY DIAGENESIS IN BIOADVECTIVE SEDIMENTS: RELATIONSHIPS BETWEEN THE DIAGENESIS OF BERYLLIUM-7, SEDIMENT REWORKING RATES, AND THE ABUNDANCE OF CONVEYOR-BELT DEPOSIT-FEEDERS,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W87-07594

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

TEST OF PROTOTYPE REVERSE OSMOSIS ENERGY RECOVERY DEVICE AND CORRECTION OF ITS DEFICIENCIES,
Polymetrics, Inc., Santa Clara, CA.
J. P. Pelmulder.
Available from the National Technical Institute Service, Springfield, Virginia 22161, as PB87-187399/AS, A04 in paper copy, A01 in microfiche. Bureau of Reclamation, Final Report, July 1983. 52 p, 11 fig, 4 ref. Bu Rec Contract 14-34-0001-2412.

Descriptors: *Reverse osmosis, *Energy, *Desalination, Hydraulic energy, Positive displacement, Performance evaluation, Economic aspects.

The objective of reducing the energy requirements of desalination has become increasingly important as the cost of energy has been rising in recent years. Also, reverse osmosis has become an accepted technology for sea water desalination. About 70% of the input energy to a sea water reverse osmosis desalination process leaves as hydraulic energy in the waste brine which is dissipated through a throttle valve and sent to drain. There are two basic methods for recovering this hydraulic energy: centrifugal devices, such as hydroturbine and pelton wheels, and positive displacement devices. General technology for the centrifugal devices is well established and could be economically applied to large (2.5 mgd) reverse osmosis plants where peak efficiencies would be in the order of 88 to 90%. Efficiencies drop off rapidly and unit costs rise as the size of the plants become smaller. The positive displacement devices on the other hand are particularly promising for plants below 200,000 gpd because their high efficiency (over 90%) is not greatly affected by scale and the device itself replaces the majority of the pumping capacity required. A prototype energy recovery device was refurbished and integrated with a reverse osmosis simulator for further testing. A valve test stand was also constructed and several valves were tested. During testing there were continuing reliability problems with the many valves in the system. It appears that the use of many separate components creates an excessively complicated system with too many potential failure points. It is recommended that further work should investigate other approaches to the equipment arrangement which would provide a simpler and more unified system. One alternate approach was studied which may provide those advantages. (Lantz-PTT)
W87-07424

EVALUATION OF 'QUANTUM' BRACKISH WATER MODULES,
Dow Chemical U.S.A., Walnut Creek, CA. Western Div. Research Labs.
G. B. Clark, P. A. Thibos, and J. A. Jensvold.
Available from the National Technical Institute Service, Springfield, Virginia 22161, as PB87-187365/AS. Price codes: A05 in paper copy, A01 in microfiche. Dow Chemical Company, We stern Division, Final Report, March 1986. 79 p, 18 fig, 2 append. Geological Survey Contract 14-34-0001-0501.

Descriptors: *Desalination, *Reverse osmosis, *Brackish water, *Saline water, Performance evaluation, Hydraulic structures, Pressure vessels, Flow pattern.

This is a cost-share program for the testing and evaluation of three sizes of large, hollow-fiber, reverse osmosis desalination modules called 'Quantum'. The sizes, in terms of module diameters, were 14, 18 and 24 inches, with the nominal productivities being 60,000, 120,000 and 240,000 GPD, respectively. The two smaller units, 14-in and 18-in modules, were tested for six months (180 days) and the 24-in module was operated for four months (120 days). Performance data on these modules were taken regularly to discern any significant trends during the course of the test period. On the whole, the three different sized Quantum modules tested all performed relatively well. The pressure vessel on all three sizes maintained constant 250 - 300 psi operation with no signs of leaking or weeping throughout their respective tests. Slippage of the fiber bundle in the 24-in module suggests a problem with the stability of the larger fiber bundles, but one that could be easily remedied. In terms of performance, all modules performed very close to what would have been projected for them based on membrane properties of the fiber going into them (except for the 24-in module after the bundle shift). The loss of productivity with time for the 14-in and 18-in modules is indicative of 300 psi operation. In terms of flow distribution, the larger modules should have performed better, resulting from their increased water velocities near the core of the module. Indeed, the 18-in module showed less scale than the 14-in module when they were both autopsied. Because of the bundle shifts in the 24-in module, scale did form in the blocked-off half of the module but still to a lesser degree than the 14-in module. (Lantz-PTT)
W87-07425

3B. Water Yield Improvement

EVALUATING PRECIPITATION MODIFICATION UNDER DROUGHT CONDITIONS FOR UTAH AGRICULTURE,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
G. M. Perry, and T. F. Glover.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1918-1925, December 1986. 1 fig, 1 tab, 15 ref.

Descriptors: *Model studies, *Drought, *Weather modification, *Climatology, *Rainfall, Utah, Agriculture, Simulation, Crop yield, Equations, Prediction, Cloud seeding, Costs.

The impacts of the 1934 and 1977 droughts in the seven climatological regions of Utah were examined using a linear programming model that simulated crop and livestock production in Utah for 1979. Crop and range production equations were developed to predict changes in production of feed and food crops during the drought before and after cloud seeding was implemented. The simulations indicated that the costs of both droughts fell large-

ly on the livestock industry statewide and on the crop industry in northwestern and southeastern Utah. Cloud seeding was most beneficial in these latter two regions. (Author's abstract)
W87-07509

FURTHER EXPLORATORY ANALYSIS OF THE BRIDGER RANGE WINTER CLOUD SEEDING EXPERIMENT,
Bureau of Reclamation, Montrose, CO.
A. B. Super.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1926-1933, December 1986. 4 fig, 2 tab, 7 ref. DOI Contract 14-06-D-6798.

Descriptors: *Climatology, *Weather modification, *Cloud seeding, *Bridger Range, Rawinsondes, Silver iodide, Rainfall, Precipitation, Winds, Clouds, Temperature.

Further exploratory analysis of the Bridger Range Experiment was carried out with 6 h data blocks partitioned from the original 24 h experimental units. The analysis was limited to 6 h periods having a rawinsonde observation, Main Ridge temperature < or = -9 C and westerly flow. The results suggest that silver iodide seeding was particularly effective in increasing precipitation in a small fraction of the cases, but had little or no effect most of the time. Seeding appeared to be especially effective when cloud top temperatures were warmer than about -25 C and the wind had a strong cross-barrier component. Marked decreases in precipitation were not apparent during seeded periods. (Author's abstract)
W87-07510

AIRCRAFT OBSERVATIONS OF TRANSPORT AND DIFFUSION IN CUMULUS CLOUDS,
North Dakota Univ., Grand Forks.
J. L. Stith, D. A. Graffith, R. L. Rose, J. A. Flueck, and J. R. Miller.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1959-1970, December 1986. 8 fig, 2 tab, 28 ref. Bu Rec Contract 9-07-85-V0026.

Descriptors: *Cloud physics, *Climatology, *Tracers, *Cloud seeding, *Aerosols, *Clouds, Transport, Diffusion, Sulfur hexafluoride, Plumes, Model studies, Remote sensing, Simulation, Convection, Ice.

A gaseous tracer, sulfur hexafluoride, was used to follow the path of two different AgI cloud seeding aerosols in cumulus clouds. The materials were released at cloud base or midlevels. Plumes sampled at midlevels were found to be relatively narrow and embedded within updrafts or downdrafts; relatively high concentrations of the tracer were observed in some downdrafts. Plumes with diameters comparable to the cloud diameters were found in the upper 20% of the clouds. These observations suggest only limited dispersion of the plumes in the clouds, with greater mixing occurring at cloud top. Similar behavior of the in-cloud plume is observed in results from a two-dimensional, numerical cloud model used to simulate the introduction of seeding materials into convective clouds. Observations of the ice crystal production rates are consistent with the results of recent laboratory findings concerning the properties of the seeding agents. The usefulness of this tracer technique in studying transport, diffusion and ice activation in cumulus clouds is discussed. (Author's abstract)
W87-07511

NUMERICAL MODELING OF HAILSTONE GROWTH. PART I: PRELIMINARY MODEL VERIFICATION AND SENSITIVITY TESTS,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W87-07514

DROUGHT AND WATER MANAGEMENT: THE EGYPTIAN RESPONSE,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
S. E. Smith.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 5, p 297-300, September-October 1986. 2 fig, 2 tab, 13 ref.

Descriptors: *Drought, *Water management, *Water policy, *Egypt, *Political constraints, *Nile River, Public policy, Economic aspects, Irrigation practices, Agriculture, Water use, Water demand, Hydrology, Dams, Reservoirs, Conservation, Water conservation, Crop production, Water reuse, Wastewater renovation.

Beginning in 1979, the Sahel and East Africa have suffered from the worst drought in 70 years as the Sahara desert creeps southward. Meanwhile, sub-Sahara Africa has one of the lowest growth rates in food production and highest population growth rates of any region over the past 20 years. The causes of drought and political constraints on water management in the region are discussed. Economic systems are required that reward efficient farming while discouraging wasteful use of water and land. Under present communal ownership, individuals do not take responsibility or receive benefits from the land. Water conservation measures are suggested, including: (1) reduction of withdrawal from the Aswan Reservoir for hydroelectric power production; (2) reuse of agricultural drainage water; (3) nighttime irrigation to reduce evapotranspirative losses; and (4) elimination of vegetation from canals. Additional measures include: (1) modifying crop patterns (cultivation of low-water-demand crops); (2) use of groundwater in Delta aquifers; (3) reduction of evaporation from the Aswan Reservoir; (4) completion of projects with the Sudan and Uganda on the upper Nile to capture more runoff. (Doria-PTT)
W87-07560

3C. Use Of Water Of Impaired Quality

WATER-SALINITY-PRODUCTION FUNCTIONS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
K. H. Solomon.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1975-1980, November-December 1985. 5 fig, 1 tab, 26 ref.

Descriptors: *Productivity, *Salinity, *Impaired water use, *Water pollution effects, *Mathematical studies, *Irrigation, Water management, Crop yield, Salt tolerance, Leaching.

Water-salinity-production functions are mathematical expressions of the relationship between crop yield and the amount and salinity of applied water. If available, such relationships would be valuable aids to the study of water management practices throughout the arid West, where salinity can be a problem. A model was developed for constructing water-salinity-production functions based on current understanding of crop response to water, crop salt tolerance, and the leaching process. Available theory and data from which to derive water-salinity-production functions are assessed, and a numerical example is given. (Author's abstract)
W87-06668

ION-ASSOCIATION MODEL FOR HIGHLY SALINE, SODIUM CHLORIDE-DOMINATED WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2K.
W87-06728

MICROBIOLOGICAL ASPECTS OF FISH GROWN IN TREATED WASTEWATER,
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5C.
W87-06748

VIRUS SURVIVAL ON VEGETABLES SPRAY-IRRIGATED WITH WASTEWATER,
Fairfield Hospital for Communicable Diseases (Australia). Virus Lab.
For primary bibliographic entry see Field 5B.
W87-06755

SIGNIFICANCE OF SULFIDE OXIDATION IN SOIL SALINIZATION IN SOUTHEASTERN SASKATCHEWAN, CANADA,
Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
For primary bibliographic entry see Field 2G.
W87-06808

WATER MANAGEMENT AND REUSE OF COAL CONVERSION PROCESS CONDENSATES,
Carnegie-Mellon Univ., Pittsburgh, PA.
I. Banz, D. A. Dzombak, J.-K. Fu, and R. G. Luthy.
Available from the National Technical Information Service, Springfield, Virginia, 22161. as DE84015497. Price codes: A05 in paper copy, A01 in microfiche. DOE Report No. DOE/PC/30262-3, June 1984. 86 p, 9 fig, 14 tab, 56 ref.

Descriptors: *Impaired water use, *Cooling water, *Water reuse, *Water management, *Coal, Industrial wastewater, Calcium sulfate, Chemical oxygen demand, Organic carbon, Model studies, Wastewater treatment.

A three-part investigation assessed certain aspects of water management and wastewater reuse for coal conversion facilities. The first part of the study examined zero discharge-oriented water management strategies for solvent refined coal (SRC) liquefaction facilities. This work showed that the use of wastewater as cooling tower makeup is one of the most significant means of reducing both aqueous discharges and fresh water consumption. Conceptual process water balances were developed which showed that wastewater reuse as cooling tower makeup with sidestream softening could result in appreciable reduction in raw water withdrawal, as well as reduced flow to an evaporator and reduced waste brine flow. There are various problems associated with reuse of process wastewater as cooling tower makeup water, including the need to evaluate chemical speciation and chemical reactions in wastewater being employed as makeup water. For this reason, the next part of the study was directed towards measurement of calcium sulfate solubility in wastewater. Calcium sulfate solubility product and ion pair dissociation constant were measured in clean water and a pretreated coal conversion process wastewater to assess the tendency for organic matter in the wastewater to function as a complexing agent for calcium. It was demonstrated that organic matter interacted with calcium to form a calcium-organic complex. The extent of this interaction in wastewater was as significant as that for formation of the CaSO4 ion pair in assessing solubility of CaSO4. It was shown that the organic matter complexed with calcium to an extent comparable to humic acid, and that the complexing strength was similar to that which is predicted for citrate when compared on an equivalent COD or TOC basis. The results of this part of the study are important for evaluating CaSO4 scale-forming reactions if wastewater is to be reused as makeup water to an evaporating cooling tower. (Lantz-PTT)
W87-06928

LOW-COST WATER SUPPLY AND SANITATION TECHNOLOGY: POLLUTION AND HEALTH PROBLEMS.
World Health Organization, New Delhi (India). Regional Office for South-East Asia.
For primary bibliographic entry see Field 5D.
W87-06937

EFFECTS OF NACL AND CACL2 ON CELL ENLARGEMENT AND CELL PRODUCTION IN COTTON ROOTS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2I.
W87-07133

LAND APPLICATION SYSTEMS SHOW VERSATILITY,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
For primary bibliographic entry see Field 5E.
W87-07165

3D. Conservation In Domestic and Municipal Use

NETWORK MODEL FOR DECISION-SUPPORT IN MUNICIPAL RAW WATER SUPPLY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-06686

OPTIMAL TESTING FREQUENCY FOR DOMESTIC WATER METERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W87-06706

STRATEGIC USE OF TECHNICAL INFORMATION IN URBAN INSTREAM FLOW PLANS,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
For primary bibliographic entry see Field 6B.
W87-06709

STORM SEWER DESIGN SENSITIVITY ANALYSIS USING ILSD-2 MODEL,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W87-06716

INPUT SUBSTITUTION AND DEMAND IN THE WATER SUPPLY PRODUCTION PROCESS,
Western Kentucky Univ., Bowling Green. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W87-07105

SMALL COMMUNITIES HELP THEMSELVES,
For primary bibliographic entry see Field 6B.
W87-07168

PROJECTED INCREASES IN MUNICIPAL WATER USE IN THE GREAT LAKES DUE TO CO2-INDUCED CLIMATIC CHANGE,
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 6D.
W87-07184

WATER CONSERVATION METHODS IN URBAN LANDSCAPE IRRIGATION: AN EXPLORATORY OVERVIEW,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 147-152, February 1987. 1 fig, 3 tab, 11 ref.

Descriptors: *Landscaping, *Water conservation, *Landscape irrigation, *Irrigation efficiency, Urban areas, Water demand, Maintenance, Irrigation, Water use.

The increasing use of irrigation for urban landscapes is causing new demands for efficient watering systems. Conservation techniques for irrigated agricultural fields cannot be applied to urban landscapes without amendment. This paper attempts to review methods of urban landscape water conservation in the context of the diversity and complexity of urban landscapes and the demands upon them for quality of the urban environment. A development's initial site layout and planting design fundamentally determine how much irrigation water will be required; the complexity and creativity inherent in urban design open a number of specific possibilities for reducing water demand. Irrigation hardware is then designed to deliver the required volume of water to the specified landscape efficiently by implementing a number of physical and operational principles. Maintenance of the finished development involves monitoring results and making adjustments as the plantings grow and develop. The potential for conserving urban irrigation water is large. Effective conservation need not compromise other qualities of the urban environment such as aesthetics, screening, or shade. Urban design can address both the kinds of landscapes people need, and minimal consumption of irrigation water. (Author's abstract)
W87-07191

ACHIEVING SUCCESS IN COMMUNITY WATER SUPPLY AND SANITATION PROJECTS.
World Health Organization, New Delhi (India). Regional Office for South-East Asia.
For primary bibliographic entry see Field 6B.
W87-07363

TRACE ORGANICS REMOVAL BY GRANULAR ACTIVATED CARBON,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W87-07392

TREATMENT OF DOMESTIC WASTEWATER FOR REUSE WITH INORGANIC OXIDE ADSORBENTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-07393

ECONOMIC EVALUATION OF CONSERVATION CONCEPTS FOR MUNICIPAL WATER SUPPLY SYSTEMS,
Utah Water Research Lab., Logan.
T. C. Hughes, R. Narayanan, M. McKee, A. B. Bishop, and R. LeConte.
Available from National Technical Institute Service, Springfield Virginia 22161, as PB87-190617/AS, Price codes: A08 in paper copy, A01 in mircofiche. September 1986. 142 p, 40 fig, 43 ref, append. DOI Grant 14-08-0001-G-1063.

Descriptors: *Municipal water, *Water supply, *Economic aspects, *Water conservation, *Utah, *Flow regulators, *Model studies, Water rates, Drinking water, Irrigation, Water conveyance, Seasonal variation, Metering, Water use, Water demand.

Five concepts for conservation of municipal water supply are analyzed from an economic efficiency perspective. They include: (1) seasonal pricing (for reduction of peak period water use), (2) dual water systems (separate high quality drinking water and untreated outdoor irrigation systems), (3) imported water transmission facility capacity optimization, (4) flow restricting devices, and (5) short-term rationing concepts. Optimization models, including generalized model generators, were developed for analysis of the first three concepts, and model applications to cities in Utah were demonstrated for each. The flow restricting device and short-term rationing concept analyses were based upon approaches taken from the literature but applied to example sites in Utah. The final chapter is a comparison of results and summary of conditions which favor each approach to conservation. Conclusions include: seasonal pricing was demonstrated to reduce peak period water use but is not justified in Salt Lake City because the added cost of metering exceeds the additional benefits. Dual water systems are potentially an important concept for matching various qualities of water with appropriate uses and producing net economic benefits. Determination of capacity of an imported water facility is dominated more by the decision maker's attitude toward risk than by pricing policy. Flow restricting devices produce economic benefits only if the change in quality of service is ignored. Price elasticity is much lower during a drought than during normal conditions. (Author's abstract)
W87-07421

URBAN WATER PRICING AND DROUGHT MANAGEMENT,
Hawaii Univ. at Manoa, Honolulu. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W87-07470

3E. Conservation In Industry

ANALYSIS OF WATERS ASSOCIATED WITH ALTERNATIVE FUEL PRODUCTION.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5A.
W87-06871

WATER FOR SUBSURFACE INJECTION.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W87-06888

INVESTIGATION OF INJECTION PROBLEMS OF A PRODUCED WATER DISPOSAL SYSTEM WITH EMPHASIS ON REDOX POTENTIAL MEASUREMENT FOR SOLVING INJECTION PROBLEMS IN THE FIELD,
Nalco Chemical Co., Sugar Land, TX.
For primary bibliographic entry see Field 5E.
W87-06889

ELECTROCHEMICAL HYDROGEN PATCH PROBE CORRELATED TO CORROSION RATE IN A SLIGHTLY SOUR WATER FLOOD,
Petrolite Instruments, Houston, TX.
For primary bibliographic entry see Field 7B.
W87-06890

CHARACTERIZATION OF UNSTABLE WATERS BY SEEDED CRYSTAL GROWTH TECHNIQUES,
Occidental Research Corp., Irvine, CA.
For primary bibliographic entry see Field 5G.
W87-06891

SOME FACTORS CONTRIBUTING TO DECREASED WELL EFFICIENCY DURING FLUID INJECTION,
Woodward-Clyde Consultants, Denver, CO.
A. I. Johnson.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 89-101, 7 fig, 15 ref.

Descriptors: *Wells, *Injection, *Injection water, *Groundwater recharge, Water use, Industrial water, Efficiency, Injection, Clogging, Aquifers, Groundwater.

Many factors affecting fluid injection through wells involve clogging of the well and injection zone. Extensive field research carried out in the Grand Prairie Region of Arkansas, supported by special laboratory testing, involved the injection of surface waters into native waters of the local aquifers. The principal causes of clogging were found to be gas binding or air entrainment in the injection zone, suspended particles in the injection fluid, bacterial contamination of the injection zone by the injection fluid and subsequent clogging by bacterial growths, mechanical jamming of the injection zone and gravel pack around the well caused by particle rearrangement when the direc-

tion of fluid movement into and through the injection zone is reversed, and chemical reactions between the injection fluid and the native groundwater or the particles in the injection zone. The results indicated that the efficiency of the injection well could be reduced by as much as 50% by such factors and that treated injection fluid therefore would be advisable. Other problems in operating an injection well included the effects of injecting fluid of a different temperature and viscosity and the interpretation of fluid-level changes in the injection zone during the injection tests because most clogging was found to take place within a few feet of the injection well. Laboratory tests were used successfully to make preliminary estimates of the hydraulic characteristics of the injection zone prior to field testing of those properties. Laboratory experiments also showed that a permeability reduction of as much as 45% resulted from compaction of the gravel pack caused by surging action during well development and from the pumping and injection tests. (See also W87-06888) (Author's abstract)
W87-06895

WASTEPAPER FIBERS IN CEMENTITIOUS COMPOSITES,
Steinbrugge, Thomas and Bloom, Inc., Newport Beach, CA.
For primary bibliographic entry see Field 8F.
W87-07120

EVALUATION OF OXIDATION/BIOLOGICAL ACTIVATED CARBON TREATMENT FOR INDUSTRIAL WATER REUSE,
Jacobs Engineering Group, Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W87-07394

NATIONAL PROTOTYPE COPPER MINING WATER MANAGEMENT PLAN,
Central Arizona Association of Governments, Florence.
For primary bibliographic entry see Field 5G.
W87-07429

3F. Conservation In Agriculture

IRRIGATION EQUIPMENT FOR PLOT RESEARCH,
Agricultural Research Service, Suffolk, VA. Tidewater Research and Continuing Education Center.
F. S. Wright.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1741-1743, November-December 1985. 6 fig, 9 ref.

Descriptors: *Irrigation equipment, *Irrigation, *Irrigation operations, Pipes, Sprinklers, Field tests, Automation, Pumps, Agriculture, Pesticides, Fertilizers, Tractors.

Applying and controlling irrigation water to research plots or small land areas in field crop studies has been difficult for researchers. The necessity for cultivation and spraying equipment to pass through the plot areas during the growing season requires a field clear of piping, sprinklers, and other irrigation accessories. A low-pressure irrigation system developed for applying water to research plots is described. The unit moves in a linear fashion and spans 36.5 m (120 ft). After watering, there are no pipe or obstructions to interfere with tractor-operated equipment. Pesticides or fertilizers can be injected into the irrigation water. Remote control features were incorporated for water control and injection pump operation. The irrigation equipment applies water satisfactorily for field crop research. (Alexander-PTT)
W87-06638

SOIL LOSS AND TIME TO EQUILIBRIUM FOR RILL AND CHANNEL EROSION,
British Columbia Univ., Vancouver. Dept. of Soil Science.
For primary bibliographic entry see Field 2J.
W87-06639

RESPONSE OF TEN CORN CULTIVARS TO FLOODING,
Agricultural Research Service, Columbus, OH. Soil Drainage Research Unit.
For primary bibliographic entry see Field 2D.
W87-06640

DRAINAGE WATER QUALITY FROM POTATO PRODUCTION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W87-06641

SOIL WATER INFILTRATION AS AFFECTED BY THE USE OF THE PARAPLOW,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W87-06643

PREDICTING INFILTRATION FOR SHALLOW WATER TABLE SOILS WITH DIFFERENT SURFACE COVERS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W87-06646

SPATIAL VARIABILITY OF INFILTRATION IN FURROWS,
Instituto Tecnologico y de Estudios Superiores de Monterrey (Mexico).
For primary bibliographic entry see Field 2G.
W87-06648

WATER TABLE EFFECTS ON NUTRIENT CONTENTS OF CELERY, LETTUCE AND SWEET CORN,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W87-06652

FURROW HYDRAULIC CHARACTERISTICS AND INFILTRATION,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2G.
W87-06658

EVALUATION OF CENTER PIVOT APPLICATION PACKAGES CONSIDERING DROPLET INDUCED INFILTRATION REDUCTION,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
R. D. von Bernuth, and J. R. Gilley.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1940-1946, November-December 1985. 5 fig, 5 tab, 17 ref, 3 append.

Descriptors: *Center pivot irrigation, *Infiltration, *Model studies, *Irrigation design, *Pumping energy, *Runoff, *Computer models, Soil types, Flow rates, Soil properties, Energy, Distribution, Irrigation, Costs.

Center pivot irrigation systems have become widely accepted for irrigation of field crops, but the rapid rise in energy costs in the last decade has led to adoption of sprinkler application packages that operate at reduced pressures. The use of reduced operating pressure packages does lead to decreased pumping power, but disadvantages such as reduced infiltration and increased application rates may result. Total pumping energy consumed depends upon pumping power and total infiltrated water. Both factors must be considered when comparing packages. A computer model for predicting potential runoff under popular application packages produced results which compared favorably with field tests. A method for calculating infiltration reduction based upon droplet size, droplet velocity, and soil particle size was presented and used in the model. The potential runoff model was used to evaluate application packages relative to each other and to rank an order of preference of packages for each soil type. The order of preference changes with flow rate, surface storage, and soil type and should be used with discretion. Spray type systems were most acceptable on sandy soils only if some surface storage was assumed. Because potential runoff exists and can be very high, the use of center pivots on fine textured soils should be carefully analyzed. There is no best system to use, but 180 deg spray appears to be the worst. An economic basis for selection among application packages was presented. With this method the actual pumping cost difference between two alternative packages can be determined. The method accounts for both distribution pressure differences and potential runoff differences, and may lead to a selection which is different from that based upon potential runoff alone. In all cases a reduced pressure package was the most economical. (Author's abstract)
W87-06663

WATER-TABLE AND IRRIGATION EFFECTS ON CORN AND SUGARBEET,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
L. C. Benz, E. J. Doering, and G. A. Reichman.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1951-1956, November-December 1985. 4 tab, 24 ref.

Descriptors: *Irrigation, *Water table, *Corn, *Sugarbeets, *Lysimeters, *Crop yield, *Evapotranspiration, Rainfall, Field tests.

The effects of four shallow constant water-table depths and three surface irrigation levels on corn and sugarbeet yields and actual evapotranspiration (ET), were evaluated in a field-installed nonweighing lysimeters experiment. Corn total dry matter and corn grain yields were uniformly high for all three irrigation levels at the 101-cm water-table depth. At the 155-cm and 210-cm water-table depths, corn yields usually increased with greater surface irrigation. Sugarbeet yields varied considerably between water-table depths and among irrigation levels within a given water-table depth. Both corn and sugarbeet yields were much lower for the shallowest (46 cm) water table treatment. Average seasonal ET was about 519 mm for corn and was about 591 mm for sugarbeet after combining data from all water-table depths and irrigation levels. About 63% of total ET was provided by subirrigation in one lysimeter with the lowest surface irrigation level and 155-cm water table. Subirrigation from shallow water tables (101, 155, and 210 cm) contributed to ET in sizable quantities if rainfall and surface irrigation were inadequate. (Author's abstract)
W87-06664

CABLEGATION: VI. THE WATERBRAKE CONTROLLER,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
D. C. Kincaid.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1957-1960, November-December 1985. 4 fig, 5 ref.

Descriptors: *Irrigation, *Waterbrake, *Cablegation, Hydraulic machinery, Design criteria, Equations, Automation.

The waterbrake was developed as a low cost means of controlling the plug speed in the cablegation automated surface irrigation system. The waterbrake is a simple hydraulic device requiring no external power source and can be built with locally available materials. The design equations are an extension of those presented in the previous papers. The cable reel design is also discussed. (Author's abstract)
W87-06665

WIND TUNNEL STUDY OF SPRINKLER CATCH-CAN PERFORMANCE,
Franzoy, Corey Engineers and Architects, Phoenix, AZ.
P. Livingston, J. C. Loftis, and H. R. Duke.

Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1961-1965, November-December 1985. 5 fig, 8 ref.

Descriptors: *Wind effects, *Measuring instruments, *Sprinkler catch-cans, *Rain gages, *Simulated rainfall, Precipitation, Wind speed, Wind tunnels, Performance evaluation.

An indoor wind tunnel was constructed to evaluate wind effects on sprinkler catch-can performance. A rain simulator in the tunnel ceiling was used to represent application from a sprinkler. Can catch depths were compared to known precipitation depths at varied can heights, wind speeds, and surface roughness. An inverse relationship was found between wind speed and percent catch. (Author's abstract)
W87-06666

DROP SIZE DISTRIBUTIONS FOR IRRIGATION SPRAY NOZZLES,
Agricultural Research Service, Riverside, CA. Salinity Lab.
K. H. Solomon, D. C. Kincaid, and J. C. Bezdek.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1966-1974, November-December 1985. 11 fig, 5 tab, 25 ref.

Descriptors: *Model studies, *Drop size, *Irrigation systems, *Spray nozzles, Distribution function, Pressure, Performance evaluation, Predicting.

Drop size distributions for irrigation spray nozzles, such as may be used in low or reduced pressure sprinkler systems, were measured with a calibrated stain technique. Similar data from other sources, measured with photographic or pellet techniques, were also obtained. The distributions were fitted with the upper limit log normal (ULLN) distribution function. ULLN parameters for each distribution are tabulated. Distribution characteristics such as the volume median drop size may be calculated directly from the ULLN parameters. A simple regression model for predicting ULLN parameters as functions of nozzle style, size and pressure is proposed and fitted to data for flooding and smooth flat plate spray nozzles. The fit of model to data was evaluated by comparing measured and predicted values for 50th (median) and 99th (volume) percentile drop sizes, and by directly comparing measured and predicted distribution functions. The distance between functions was defined analogous to the Euclidean distance between points in space, leading to definition of a pseudo r squared for the (functional) regression model. The fit between data and model for the two nozzle types was quite good. The models were used to explore the influence of nozzle size and pressure on drop size distributions for the two types of nozzles. (Author's abstract)
W87-06667

LOW-PRESSURE WATER DISTRIBUTION SYSTEM IN IRRIGATION MACHINES,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
I. Amir.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1981-1985, November-December 1985. 3 fig, 1 tab, 4 ref.

Descriptors: *Irrigation, *Hydraulic machinery, *Emitters, Flow regulators, Distribution, Pressure, Flow rates.

A low-pressure water distribution system of an irrigation machine is presented. The system divides the water entering the machine equally between the emitters and continuously adjusts the speed of the machine to the entering flow rate so as to maintain a predetermined water application amount. While most existing control systems are based on flow regulators, this system includes a set of main and secondary gravitational distributors. Water distribution uniformity achieved is high (>95%) at a relatively low pressure (30 to 50 kPa). (Author's abstract)
W87-06669

PORTABLE FLOW METERING DEVICE FOR FURROW IRRIGATION STUDIES,
Nebraska Univ., Clay Center. South Central Research and Extension Center.
For primary bibliographic entry see Field 7B.
W87-06670

WATER DUTIES: ARIZONA'S GROUNDWATER MANAGEMENT APPROACH,
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 4B.
W87-06712

BIOCHEMICAL OXYGEN DEMAND OF AGRICULTURAL RUNOFF,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 5A.
W87-06718

NITRATE LEACHING AND DRAINAGE FROM ANNUAL AND PERENNIAL CROPS IN TILE-DRAINED PLOTS AND LYSIMETERS,
Sveriges Lantbruksuniversitet, Umea.
For primary bibliographic entry see Field 5B.
W87-06719

CORN AND WHEAT RESPONSE TO TOPSOIL THICKNESS AND PHOSPHORUS ON RECLAIMED LAND,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2I.
W87-06727

ENERGY CONSERVATION IN THE IRRIGATED AGRICULTURE SECTOR OF THE PACIFIC NORTHWEST,
Battelle Pacific Northwest Labs., Richland, WA.
B. J. Harrer.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84013249, Price codes: A02 in paper copy, A01 in microfiche. Pacific Northwest Lab. Report No. PNL-SA-12251, April 1984. 17 p, 3 fig, 5 tab, 3 ref. CONF-8405200-1.

Descriptors: *Irrigation practices, *Energy conservation, *Cost analysis, *Washington, *Oregon, *Idaho, Agriculture, Irrigation efficiency, Electricity, Utilities.

Traditionally, irrigation of crops in most areas of the Pacific Northwest (PNW) region has been considered an energy-intensive activity, and almost all of the energy used in regional irrigation is in the form of electricity. The annual energy used in applying water to crops in arid areas often exceeds 2000 kWh per acre. The rise in the costs of energy used in irrigation has been dramatic. In the 5-year period between 1978 and 1982, the nominal rates charged for large irrigation customers more than doubled in one utility service area (Benton County PUD 1982), and similar increases were experienced in other areas as utilities passed BPA wholesale power rate increases onto their customers. On a farm where energy costs per acre were $25/acre in 1978, costs would exceed $50/acre in 1982. In real terms, the rates charged for electricity used in irrigation rose at an annual rate of 7% during the 5 year period. From an economists's perspective, conservation in irrigated agriculture provides an interesting illustration of how conservation that is cost effective from a utility or regional standpoint may not be cost effective from an individual firm's perspective. Through subsidization of selected conservation investments, utilities, irrigators, and the PNW region as a whole have opportunities to realize benefits. The model studies used demonstrate that energy savings are available in the irrigation sector of the PNW region for a relatively low cost. A generation cost of 50 mills per kWh is probably a lower bound for the cost of electricity than could be obtained from a new generating plant in the region. By obtaining all energy savings on existing irrigation acreages that can be realized for a cost less than 50 mills per kWh saved, the addition of almost 100 average MW of energy to the regional generating system could potentially be avoided. (Lantz-PTT)
W87-07026

CORN YIELD AND WATER USE AS INFLUENCED BY IRRIGATION LEVEL, N RATE, AND PLANT POPULATION DENSITY,
Kansas State Univ., Manhattan. Dept. of Agronomy.
K. B. Bakelana, L. R. Stone, C. E. Wassom, and A. D. Dayton.
Transactions of the Kansas Academy of Science, Vol. 89, No. 1/2, p 110-118, 1986. 3 fig, 3 tab, 6 ref.

Descriptors: *Irrigation effects, *Nitrogen, *Population density, *Corn, *Crop yield, *Water use, Fertilizers, Plant growth, Food crops, Grain crops, Silt, Loam, Irrigation.

This field investigation near Manhattan, Kansas in 1979 and 1980 includes the influence of irrigation level, N fertilization rate, and plant population density on corn (Zea mays L.) yield (grain and total dry matter) and water use. The soil was Muir silt loam. In 1979, plant population density did not influence grain yield. Grain yield was not influenced by N rate in 1979, but was increased by N fertilizer applications in 1980. In 1980, corn receiving no irrigation and two irrigations produced 1 and 69 percent, respectively, as much grain as corn receiving seven irrigations. Seasonal water use was influenced by plant population density each year but not by N fertilization rate either year. Water use increased significantly in 1980 as irrigation level increased. (Author's abstract)
W87-07090

EFFECT OF OSMOTIC STRESS ON ION TRANSPORT PROCESSES AND PHOSPHOLIPID COMPOSITION OF WHEAT (TRITICUM AESTIVUM L.) MITOCHONDRIA,
Agricultural Research Service, Lubbock, TX. Plant Stress and Water Conservation Research Unit.
For primary bibliographic entry see Field 2I.
W87-07132

ASSESSMENT OF SELECTED LEGAL/INSTITUTIONAL CONSTRAINTS TO WATER CONSERVATION IN THE WESTERN STATES,
Teknekron Research, Inc., Berkeley, CA.
For primary bibliographic entry see Field 6E.
W87-07305

INVESTMENTS IN LARGE SCALE INFRASTRUCTURE IRRIGATION AND RIVER MANAGEMENT IN THE SAHEL,
Fletcher School of Law and Diplomacy, Medford, MA.
For primary bibliographic entry see Field 6B.
W87-07388

ESTIMATION OF EVAPOTRANSPIRATION BY SOME EQUATIONS UNDER HOT AND ARID CONDITIONS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W87-07448

COMPARISON OF TRENCHLESS DRAIN PLOW AND TRENCH METHODS OF DRAINAGE INSTALLATION,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W87-07451

ECONOMICS OF SUBSURFACE DRAINAGE SYSTEMS FOR ALFALFA HAY,
For primary bibliographic entry see Field 4A.
W87-07455

EVALUATION OF DROP-CHECK STRUCTURES FOR FARM IRRIGATION SYSTEMS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
A. S. Humpherys.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 505-511, 516, March-April 1986. 9 fig, 2 tab, 8 ref.

Descriptors: *Drop-check structures, *Irrigation systems, Field tests, Performance evaluation, Costs, Erosion control, Concrete structures, Design standards, Irrigation, Agriculture.

Small drop/check structures of various designs in the 28 to 115 L/s(1 to 4 cfs) flow range were installed in 1966 with their field performance evaluated in 1969. They were again evaluated in 1984 after 19 years of service. The parameters used to evaluate the structures included cost, structural integrity, stability, hydraulic performance and ditch erosion control capability. A numerical rating was given in each category. A precast concrete headwall with a rack-lined basin or plunge pool was the most economical and one of the most effective structures; however, special consideration must be given to provide sufficient headwall length and cutoff wall depth. Cast-in-place concrete structures were the most stable and generally the most costly with variable performances. Based on the study results and observations, conclusions and recommendations were made to improve the design of small drop structures. (Author's abstract)
W87-07459

MULTIFUNCTION IRRIGATION SYSTEM DEVELOPMENT,
Texas Agricultural Experiment Station, Lubbock.
W. M. Lyle, and J. P. Bordovsky.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 512-516, March-April 1986. 8 fig, 14 ref.

Descriptors: *Irrigation systems, *Pipes, *Nozzles, *Chemical application, Agricultural chemicals, Agriculture, Motors.

An irrigation system was designed and developed for the purpose of applying both water and chemicals through separate nozzle systems from the same basic moving pipe and tower structure. This paper furnishes a general description of the system. Documentation of performance will follow in an evaluation report. The primary objective of the dual nozzle system is for efficient irrigation along with very accurate application and total coverage of water conserving type chemicals such as anti-transpirants, growth regulators, and soil surface evaporation suppressants. However, all chemicals currently being used in agricultural production may also be accurately applied through the system. Both nozzle systems are completely adjustable in the vertical and horizontal directions and are dynamically operated under the control of a programmable controller. The system is propelled with conventional 480-volt, 3-phase electric motors and moves with steady uniform motion with the aid of an alignment and guidance system which utilizes variable frequency control of all motors. (Author's abstract)
W87-07460

ELECTRICAL CURRENT SENSITIVITY OF GROWING/FINISHING SWINE FOR DRINKING,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. J. Gustafson, R. D. Appleman, and T. M. Brennan.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 592-596, 600, March-April 1986. 13 fig, 2 tab, 6 ref.

Descriptors: *Animal behavior, *Drinking water, *Drinking habits, *Swine, Electrical current, Sensitivity.

Eight growing/finishing pigs were used for experiments on the relationship between drinking behavior and stray electrical currents in their drinking water with 60 Hz electrical currents, mouth-to-all hooves. Pigs, given an alternative, showed a preference for a water source with no current compared to those at 0.25 mA and above. However, when no alternative source existed, greater than 3.0 mA was needed to affect drinking time and 4.0 mA to affect consumption. (Author's abstract)
W87-07464

LONGEVITY AND EFFECT OF TILLAGE-FORMED SOIL SURFACE CRACKS ON WATER INFILTRATION,
South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 2G.
W87-07564

EFFECTS OF FLOODING ON WATER RELATIONS AND GROWTH OF THEOBROMA CACAO VAR. CATONGO SEEDLINGS,
Wisconsin Univ.-Madison. Dept. of Forestry.
For primary bibliographic entry see Field 2I.
W87-07565

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

COMPARISON OF TRANSFORMATION METHODS FOR FLOOD FREQUENCY ANALYSIS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-06683

EFFECTIVENESS OF ALUM IN A WEEDY, SHALLOW LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-06685

SEMI-DISTRIBUTED ADAPTIVE MODEL FOR REAL-TIME FLOOD FORECASTING,
Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.
For primary bibliographic entry see Field 2E.
W87-06695

SIZE AND LOCATION OF DETENTION STORAGE,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
W. P. James, J. F. Bell, and D. L. Leslie.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 15-28, January 1987. 8 fig, 3 tab,9 ref.

Descriptors: *Water storage, *Detention reservoirs, *Runoff, Channel improvement, Watersheds, Basins, Storage, Maintenance.

In general, large detention ponds are effective in controlling downstream flooding but provide no protection upstream of the facility. Small ponds located in the headwater may provide local benefits but will not control all of the watershed area. This paper provides general guidelines for sizing and locating detention facilities within a watershed. Basinwide planning, including channel improvements, is essential to prevent misapplication of detention storage. The concept of reducing the peak outflow from an on-site detention pond to the predevelopment peak discharge does not insure a reduction to the predevelopment discharge for larger streams and has little merit in sizing most detention ponds. The size of the detention ponds has little effect on the total storage required for a watershed. The amount of detention storage can be significantly reduced by selective location of detention ponds within the watershed. Small detention ponds will require considerably more land area and maintenance than regional detention ponds. Channel improvements within the watershed tend to favor use of upstream detention ponds. Multipurpose use should be incouraged to insure public support and continued maintenance of the detention facilities. (Authors' abstract)
W87-06707

COMBING HYDROLOGIC FORECASTS,
University of Western Ontario, London. Dept. of Statistical and Actuarial Sciences.
For primary bibliographic entry see Field 2E.
W87-06708

RESERVOIR MANAGEMENT IN TEXAS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
R. A. Wurbs.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 130-148, January 1987. 3 fig, 2 tab, 13 ref.

Descriptors: *Texas, *Surface water, *Surface water availability, *Water management, *Water resources development, *Reservoir operation, Runoff.

An overview of surface water management in Texas which focuses on operation of existing reservoirs is presented. Rapid population and economic growth combined with depleting groundwater reserves are resulting in ever-increasing demands being placed upon the surface water resources of the state. Public needs and objectives and numerous factors affecting reservoir operation change over time. The increasing necessity to use limited storage capacity as beneficially as possible warrants periodic reevaluations of operating policies. Comprehensive integration of water management strategies in response to changing needs and conditions could include improved reservoir system operations, reallocation of storage capacity between flood control and conservation purposes, integration of demand management with reservoir operation, and conjunctive surface and groundwater management. (Author's abstract)
W87-06715

STORM SEWER DESIGN SENSITIVITY ANALYSIS USING ILSD-2 MODEL,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
M. Nouh.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 151-158, January 1987. 4 fig, 16 ref.

Descriptors: *Storm sewers, *Model studies, *ILSD-2 model, *Flow routing, *Urban hydrology, *Urban runoff, *Design criteria, *Storm water, *Urban drainage, Cost analysis, Hyetographs, Comparison studies.

A recently developed methodology for optimal design of storm sewer systems is the Illinois Least-Cost Sewer System Design (ILSD-2) Model. The model considers conjunctively the concepts of flow routing through sewers, and the risks and uncertainties associated with the design which is optimized by using the Discrete Differential Dynamic Programming Technique. The risk in a sewer design is considered as the probability of having a flow imposed on a sewer which exceeds the capacity of the sewer, due to hydrologic and hydraulic uncertainties, uncertainties due to construction and materials, and uncertainties regarding the cost functions utilized. The study objective was to give a comparative evaluation for the variations in the generated design which might occur due to the use of different methodologies to construct the design hyetograph, to generate the overland flow hydrographs, and/or to route the flow through the sewers. The following conclusions were made: (1) The Trapezoidal hyetograph is recommended over other shapes, especially over the Uniform hyetograph which gives overdesign. (2) The more accurate the methods utilized for runoff generation and flow routing through sewers, the lower the result-

ing total cost of design, but the greater the sewer risk involved; thus methods more accurate than the Rational method are recommended for the design of storm sewer systems. (3) The Storm Water Management Model (SWMM) Method for overland flow hydrograph generation is recommended for the design of storm sewer systems. (McFarlane-PTT)
W87-06716

AUTOMATED TECHNIQUE FOR FLOW MEASUREMENTS FROM MARIOTTE RESERVOIRS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W87-06809

RUNOFF VOLUME FORECASTS CONDITIONED ON A TOTAL SEASONAL RUNOFF FORECAST,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-06812

MIXED GAMMA ARMA(1,1) MODEL FOR RIVER FLOW TIME SERIES,
Malaya Univ., Kuala Lumpur (Malaysia).
For primary bibliographic entry see Field 2E.
W87-06814

ECOLOGICAL ASSESSMENT OF MACROPHYTON: COLLECTION, USE, AND MEANING OF DATA.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 2H.
W87-06899

AQUATIC MACROPHYTON SAMPLING: AN OVERVIEW,
Breedlove Associates, Inc., Orlando, FL.
For primary bibliographic entry see Field 2H.
W87-06900

PROBLEMS IN THE USE OF CLOSED CHAMBERS FOR MEASURING PHOTOSYNTHESIS BY A LOTIC MACROPHYTE,
Texas Univ. at Dallas, Richardson. Center for Environmental Studies.
For primary bibliographic entry see Field 2H.
W87-06907

RELATIONSHIPS BETWEEN AQUATIC MACROPHYTES AND THE CHEMICAL AND PHYSICAL COMPOSITION OF THE SUBSTRATE IN KAHLE LAKE, CLARION-VENANGO COUNTIES, PENNSYLVANIA,
For primary bibliographic entry see Field 2H.
W87-06908

EVALUATION OF A 'RELIABILITY PROGRAMMING' RESERVOIR MODEL,
Institute of Atomic Energy, Otwock-Swierk (Poland).
For primary bibliographic entry see Field 2H.
W87-07103

COMPARISON OF STOCHASTIC AND DETERMINISTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPERATING RULE GENERATION,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6A.
W87-07175

COMPUTERIZED DATA BASE FOR FLOOD PREDICTION MODELING,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07177

ESTIMATING PARAMETERS OF EV1 DISTRIBUTION FOR FLOOD FREQUENCY ANALYSIS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07181

BRASS MODEL: APPLICATION TO SAVANNAH RIVER SYSTEM RESERVOIRS,
Law Environmental Services, Marietta, GA.
For primary bibliographic entry see Field 2E.
W87-07193

PRIORITIZING FLOOD CONTROL PLANNING NEEDS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07201

HYDROLOGICAL FORECASTING.
For primary bibliographic entry see Field 2A.
W87-07346

REAL-TIME FORECASTING,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-07361

MANAGEMENT FORECASTING REQUIREMENTS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
L. Duckstein, S. Ambrus, and D. R. Davis.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 559-585, 5 fig, 4 tab, 42 ref. NSF Grant CEE 8110778.

Descriptors: *Flood forecasting, *Streamflow forecasting, *Forecasting, *Management planning, *Model studies, *Decision making, Water resources development, Water management, Resources management.

Water resources management involves three groups of people: one group gathers data, the second conceives and operates forecasting models, and the third makes decisions. Ideally, these three groups should work together; practically, it often happens that they work in a compartmentalized manner. The purpose of this chapter is to give a general view of the relations between these three components of the decision-making process. Forecasting activities refer to different approaches to predict the behavior of the system described and choosing the most efficient one in order to get the most reliable forecast of the observed variables. The final objective decision-making, or management, refers to actions affecting the whole complex water resource system based on the information contained here. For the operation of complex systems such as a network of water sources and users, a general framework is to be set up. The use of a framework is proposed, where the information-response (I-R) system for flood forecasting-response systems is used. The I-R concept accounts for the possibility of imperfection or non-optimality both in information provided by sample data and decisions made on the basis of this information. System performance thus depends on both quality of information and quality of response: a perfect rainfall or demand forecast has value only if reservoir releases use this forecast according to an optimal or a near-optimal rule. (See also W87-07346) (Lantz-PTT)
W87-07362

POLLUTANT REMOVAL CAPABILITY OF URBAN BEST MANAGEMENT PRACTICES IN THE WASHINGTON METROPOLITAN AREA.
Metropolitan Washington Council of Governments, DC. Water Resources Planning Board.
For primary bibliographic entry see Field 5G.
W87-07365

CONTROL OF CATTAIL AND BULRUSH BY CUTTING AND FLOODING,
Ducks Unlimited Canada, Winnipeg (Manitoba).
R. M. Kaminski, H. R. Murkin, and C. E. Smith.
IN: Coastal Wetlands, Lewis Publishers, Chelsea, Michigan. 1985. p 253-262, 4 tab, 14 ref.

Descriptors: *Weed control, *Bulrushes, *Cattails, *Flooding, *Canada, *Cutting, Aquatic plants, Plant growth, Plant populations, Marshes, Wetlands, Vegetation.

In several marshes in western Canada, regeneration of common cattail, tule bulrush, and softstem spring-summer flooding as a method of control, was evaluated. Cutting along with inundation of the stubble significantly decreased total shoot density (50-93%) and flowering shoot density (64-97%) in all three emergent species, suggesting the technique is useful for control of emergent vegetation and enhancement of emergent vegetation-water interpersion for increased use of overgrown marshes by waterfowl and marsh birds. Of several farm implements used to cut cattail or bulrush, a tractor-drawn rotary mower was most efficient. (See also W87-07431) (Lantz-PTT)
W87-07446

MARSH MANAGEMENT BY WATER LEVEL MANIPULATION OR OTHER NATURAL TECHNIQUES: A COMMUNITY APPROACH,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-07447

COMPARISON OF TRENCHLESS DRAIN PLOW AND TRENCH METHODS OF DRAINAGE INSTALLATION,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, T. S. Colvin, and S. W. Melvin.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 456-461, March-April 1986. 4 fig, 4 tab, 15 ref.

Descriptors: *Drainage systems, *Subsurface drains, *Water table, *Crop yield, Field tests, Performance evaluation, Comparison studies, Drains, Corn, Soybeans, Drainage water.

The performance of two methods of subsurface drain installation (corrugated plastic drain pipes installed with a trencher, and a trenchless drain plow) was evaluated using five years of field data on water table heights and crop yields. Two subsurface drains, each installed with a different method, were monitored from 1980 to 1984 to compare the effect of methods of drain installation on water table heights. Subsurface drains installed with a chain trencher had lower water table heights throughout the crop growing season in comparison to the water table heights in areas drained by the plow method. Based on these water table measurements, subsurface drains installed with a chain trencher appeared to remove more drainage water from the soil than did subsurface drains installed with a plow. Data collected on corn and soybean yields from the various tillage experiments, drained by two methods of drain installation were compared. Plots drained by trenched drains yielded more than plots drained by plowed drains but differences were not statistically significant at 95% level. (Author's abstract)
W87-07451

ECONOMICS OF SUBSURFACE DRAINAGE SYSTEMS FOR ALFALFA HAY,
J. Bornstein, S. P. Skinner, and S. D. Reiling.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 484-488, March-April 1986. 8 tab, 7 ref.

Descriptors: *Drainage effects, *Economic aspects, *Drainage systems, *Alfalfa, Crop yield, Drain spacing, Forages, Hay, Drainage practices.

Yield, crop composition and survival were used to measure alfalfa crop response to three shallow subsurface drainage treatments (3, 6 and 12 m drain pipe spacings) and an undrained control on a 16 plot drainage research project. The objective was to determine the economic potential for growing quality forage on poorly drained nonstony clay

and silty clay loam marine sediments. The economic feasibility of two drainage treatments (6 and 12 m) as compared to the control was assessed based on payback period, simple and internal rates of return. There were significant increases in total hay yield, percent alfalfa in the crop and survival of crowns on drained vs undrained plots although no significant differences between drainage treatments were evident. Results indicate that drains spaced at 12 m are economically feasible if alfalfa is valued at a 20% price premium, a conservative value, over the prevailing 'all hay' price. (Author's abstract)
W87-07455

INTERNAL DRAINAGE OF FINE-TEXTURED ALLUVIAL SUBSOILS IN NORTH DAKOTA,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2G.
W87-07461

4B. Groundwater Management

DRAINAGE WATER QUALITY FROM POTATO PRODUCTION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W87-06641

MISSISSIPPI EMBAYMENT AQUIFER SYSTEM IN MISSISSIPPI: GEOHYDROLOGIC DATA COMPILATION FOR FLOW MODEL SIMULATION,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-06694

WATER DUTIES: ARIZONA'S GROUNDWATER MANAGEMENT APPROACH,
Clark Univ., Worcester, MA. Dept. of Geography.
J. L. Emel, and M. Yitayew.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 82-94, January 1987. 1 fig, 2 tab, 21 ref.

Descriptors: *Groundwater management, *Taxes, *Resource allocation, *Arizona, *Groundwater, *Water allocation, Irrigation, Reviews, Water demand.

The allocation of water places a limit on the amount of groundwater that can be used by irrigators over a designated time period. Allocation may involve several base units and time periods, and be uniform or variable. Agricultural water duties historically have been used to settle allocational disputes, adjudicate water basins, size canals, and schedule irrigation. The Arizona Department of Water Resources is now using water duties to reduce demand for groundwater in the management areas of the state. The scientific determinants that the water duty comprises are reviewed and the concept's implementation in Arizona's active management areas us described. The water duty is only one of several approaches to groundwater allocation. New Mexico, Oklahoma, and Nebraska employ approaches that differ considerably from Arizona's. Allocation in Arizona varies per acre, depending upon a farm cropping history. In the three other areas, the allocation is uniform per acre and more dependent upon supply management goals. Differences in spatial and temporal use flexibility also occur between allocation systems. Each of these differences produces efficiency and equity ramifications. (Authors' abstract)
W87-06712

EFFICIENT AQUIFER SIMULATION IN COMPLEX SYSTEMS,
Universidad Politecnica de Valencia (Spain).
For primary bibliographic entry see Field 2F.
W87-06714

RELATION BETWEEN SOIL PROPERTIES AND EFFECTIVENESS OF LOW-COST WATER-HARVESTING TREATMENTS,
Agricultural Research Service, Tucson, AZ.
W. E. Emmerich, G. W. Frasier, and D. H. Fink.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 213-219, January-February 1987. 1 fig, 7 tab, 32 ref.

Descriptors: *Soil properties, *Soil treatment, *Water harvesting, *Runoff, Field tests, Performance evaluation, Regression analysis, Equations, Prediction.

Knowledge of the relationship between soil properties and treatment performance is important to obtain maximum benefit from low-cost water-harvesting treatments. Six low-cost water-harvesting treatments were field tested on small plots by determining runoff percentages and threshold values at eight sites for 164 weeks. Effectiveness of all treatments decreased over time, with the order of effectiveness being: waxes > silicones > or = control (smoothed soil). Regression equations were developed to predict runoff percentages and threshold values based on soil properties. These equations can be used in determining which water-harvesting treatment would be most appropriate for a specific soil. All soil properties evaluated influenced the effectiveness of the water-harvesting treatments. Therefore, relationships between specific soil properties and the effectiveness of the treatments could not be established. A set of important soil properties were identified for each treatment in the regression equations, but more research is needed to determine the absolute importance of the individual soil properties in the effectiveness of the treatments. (Author's abstract)
W87-06807

STATISTICAL IDENTIFICATION OF HYDROLOGICAL DISTRIBUTED-PARAMETER SYSTEMS: THEORY AND APPLICATIONS,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
L. J. Fradkin, and L. A. Dokter.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 15-31, January 1987. 10 fig, 2 tab, 49 ref, 2 append.

Descriptors: *Model studies, *Groundwater reservoirs, *Aquifers, *Monitoring wells, Geohydrology, Groundwater, Wells, Prediction, New Zealand.

A system identification methodology for distributed-parameter model building was compared with other methodologies for modeling groundwater reservoirs. The method was applied to the analysis of New Zealand's Hutt Valley-Port Nicholson groundwater reservoir data. There were too few measurement wells to allow for the identification of a model suitable for forecasting reservoir performance. Application of the method does, however, indicate where additional wells should be drilled, so that such a model could be identified. Certain field parameters were identified to within 100%, and this accuracy was acceptable, provided all the important features of the reservoirs are represented in the model. (Author's abstract)
W87-06813

CHANGES IN THE CHEMICAL COMPOSITION OF DRINKING WATER AFTER WELL INFILTRATION IN AN UNCONSOLIDATED SANDY AQUIFER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
C. G. E. M. van Beek, and J. van Puffelen.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 69-76, January 1987. 2 fig, 4 tab, 19 ref.

Descriptors: *Drinking water, *Wells, *Aquifers, *Infiltration, *Sand aquifers, *Recharge, *Water chemistry, Oxidation, Sulfides, NItrates, Acids, Organic matter, Geohydrochemistry, Chemical reactions, Redox reactions, Dissolution.

Upon well recharge of aerobic water into an anaerobic aquifer a number of redox and dissolution reactions occur. In these redox reactions sulfides and organic material are oxidized by oxygen and nitrate present in the recharge water. Acid, produced during these redox reactions, is neutralized by calcium carbonate present in the aquifer and by the hydrogen carbonate-carbon dioxide equilibrium. Sulfides, organic material, and calcium carbonate are present in finite quantities in the aquifer. Therefore these processes will terminate after some time, and an aerobic zone will spread around the recharge well. These geohydrochemical reactions have major consequences for a system consisting of separate recharge and discharge wells with respect to the clogging of the discharge wells and to the treatment of the abstracted water to drinking water. (Author's abstract)
W87-06818

HYDROLOGIC INFLUENCES ON THE POTENTIAL BENEFITS OF BASINWIDE GROUNDWATER MANAGEMENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
E. G. Reichard.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 77-91, January 1987. 11 fig, 3 tab, 52 ref. EPA Grant CR-812699.

Descriptors: *Groundwater management, *Model studies, *Optimization, *Agricultural watersheds, *Groundwater recharge, *Streams, *Streamflow, Basins, Agriculture, Reservoirs, Salinas Valley, Water use, California.

The potential benefits of basinwide groundwater management in agricultural areas were analyzed with an optimization model. The model incorporates functions to compute spatial and temporal groundwater responses to hydraulic stresses, net agricultural revenues as a function of water use, and groundwater recharge from individual stream reaches. Stream recharge is computed on the basis of both groundwater elevations and the amount of streamflow. The model can be run either to maximize basinwide net revenue over a planning period or to simulate private optimization by individual agricultural sectors. The effects of several hydrologic factors on the benefits of basinwide groundwater management were estimated by comparing model results for conditions in the Salinas Valley in California prior to reservoir construction with a number of other hydrologic scenarios. Results indicate that basinwide groundwater management and reservoir operation may be close substitutes for each other under certain conditions, that an interesting relationship appears to exist between the potential benefits of groundwater management and the annual amount of streamflow available for recharge, and that consideration of stochastic variations in streamflow is unnecessary in the analysis of systems relying primarily on groundwater. A framework is also presented for identifying strategies that meet environmental constraints while minimizing the revenue losses to current water users. For all scenarios considered, basinwide groundwater management generates larger revenues than private optimization while using considerably less water. (Author's abstract)
W87-06819

PROPERTIES OF GROUNDWATER,
Kiel Univ. (Germany, F.R.). Dept. of General and Applied Geology.
For primary bibliographic entry see Field 2F.
W87-06998

ANALYSIS OF SALTWATER UPCONING BENEATH A PUMPING WELL,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W87-07063

HYDROGEOLOGY OF COMPLEX LENS CONDITIONS IN QATAR,
Birmingham Univ. (England). Hydrogeology Section.
For primary bibliographic entry see Field 2F.
W87-07065

CHEMICAL COMPOSITION OF RAINFALL AND GROUNDWATER IN RECHARGE AREAS OF THE BET SHEAN-HAROD MULTIPLE AQUIFER SYSTEM, ISRAEL,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2K.
W87-07069

INDIA'S BACKWATER HIGHWAYS,
K. Brueckmann, and D. Brueckmann.
Oceans, Vol. 20, No. 1, p 24-29, February 1987.

Descriptors: *Navigable waters, *India, *Transportation, *Waterways, Water resources development, Regional development, Malabar, Fishing, Rice.

The authors describe their experiences on a ferry trip from Quilon to Alleppey on the Malabar Coast of India. The itinerary covers a number of backwater canals and lagoons. Ferries are a common form of transportation. Double-ended, wind-driven boats, known as vallamgal, are the main form of commercial bulk transport. Construction of this latter type of boat rests on traditional methods: few tools, and much reliance on experience and a good eye. Fishing and ricegrowing are key parts of the backwater economy. (Airone-PTT)
W87-07135

OPTIMIZATION MODEL FOR GROUNDWATER MANAGEMENT IN MULTI-AQUIFER SYSTEMS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
H. Yazicigil, and M. Rasheeduddin.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 257-273, March 1987. 6 fig, 2 tab, 18 ref.

Descriptors: *Groundwater management, *Optimization models, *Aquifers, *Model studies, Optimization, Wells, Water allocation, Hydraulic head, Policy making, Economic aspects.

The use of embedding technique as a mechanism for coupling the simulation model of a particular groundwater system with an optimization model was extended herein to multi-aquifer systems. The combined management model is used to determine the optimal groundwater management schemes in a hypothetical multi-aquifer system under transient and steady state conditions. The model enables the determination of optimal allocation of wells in different aquifers and their pumping rates to achieve a system-wide maximum head distribution while satisfying the water production targets, well capacity restrictions, and lower bounds on hydraulic heads at critical points. Constraint and weighting methods of the multiobjective programming techniques are used to develop trade-off curves relating the sum of hydraulic heads in the whole system as well as in individual aquifers at various water production targets. The generated trade-off curves may enhance the decision maker's ability to select the best development policy from a set of alternative policies by considering other technological, financial, and legal constraints. (Author's abstract)
W87-07199

REGIONAL AQUIFER-SYSTEM ANALYSIS PROGRAM OF THE U.S. GEOLOGICAL SURVEY: SUMMARY OF PROJECTS, 1978-84,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-07312

HIGH PLAINS REGIONAL AQUIFER-SYSTEM STUDY,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-07315

FLORIDAN REGIONAL AQUIFER SYSTEM, PHASE II STUDY,
Geological Survey, Atlanta, GA.
For primary bibliographic entry see Field 2F.
W87-07333

4C. Effects On Water Of Man's Non-Water Activities

RUNOFF PREDICTION USING REMOTE SENSING IMAGERY,
Draper Engineering Research, Atlanta, GA.
For primary bibliographic entry see Field 2A.
W87-06687

FOREST HARVESTING AND WATER: THE LAKE STATES EXPERIENCE,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
E. S. Verry.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 1039-1047, December 1986. 5 fig, 3 tab, 35 ref.

Descriptors: *Streamflow, *Forests, *Clear-cutting, *Water table fluctuations, Peatlands, Flood peak, Snowmelt, Water quality, Environmental impact, Algae, Fish habitats, Agriculture, Watersheds.

The impact of forest on water has been a subject of argument for more than a century. It still is; and many studies conform that there is no single right answer in the debate. In the Lake States, clearcutting natural peatlands will not change annual streamflow nor will it seriously impact water quality if logging is done on frozen soils. However, clearcutting will cause water tables to fluctuate more, ranging from 9 cm higher to 19 cm lower than in peatlands with mature forests. Clearcutting upland hardwoods or conifers will increase annual streamflow by 9 to 20 cm 30- to 80-percent increase). Streamflow returns to preharvest levels in 12 t 15 years. Annual peak flows are at least doubled and snowmelt flood-peak increases may persist for 15 years. Water quality is not widely impacted, but operating logging equipment in stream channels will cause channel clogging by filamentous algae and loss of fish habitat. Permanent changes from forest to agricultural and urban land use on two-thirds or more of a watershed will significantly increase the size of flood peaks in the 2- to 30-year return interval storm or snowmelt. (Author's abstract)
W87-06696

CHAPARRAL CONVERSION AND STREAMFLOW: NITRATE INCREASE IS BALANCED MAINLY BY A DECREASE IN BICARBONATE,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
E. A. Davis.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 215-222, January 1987. 3 fig, 3 tab, 23 ref.

Descriptors: *Watersheds, *Chemical composition, *Chaparral, *Brush control, *Water yield, *Runoff, *Streams, *Nitrates, *Bicarbonates, Ions, Anions, Cations, Carbon dioxide, Herbicides, Arizona, Weed control.

Converting Arizona chaparral watersheds to grass by controlling the brush with herbicides increases water yield as subsurface runoff to streams. The increased stream discharge is accompanied by several hundredfold increases in the nitrate concentration of the stream water. Nitrate concentrations remained 46-69 fold above normal for 11 years or more. Nitrate ion concentration increases were balanced mainly by bicarbonate ion concentration decreases, with little change in the concentration of other anions or cations. One mechanism suggested to explain the decrease in bicarbonate that balances the increase in nitrate is the reaction of H(+)NO3(-) with HCO3(-) to give carbon dioxide and water. (Author's abstract)
W87-06831

FIVE-YEAR WATER QUALITY STUDY AT KENNECOTT'S BINGHAM CANYON MINE,
Kennecott, Salt Lake City, UT.
T. D. Vandell, S. D. Taylor, and R. A. Malone.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 3-11, 5 fig, 4 ref.

Descriptors: *Water quality, *Bingham Canyon, *Mining, *Utah, *Environmental effects, Industrial wastes, Water sampling, Monitoring, Water analysis, Geohydrology, Oquirrh Mountains.

In June 1983, Kennecott initiated a voluntary five-year multi-million dollar hydrogeologic study to evaluate water quality impacts from: (1) pre-Kennecott (1865-1936) mining operations, (2) the naturally occurring mineralized zones found upgradient in the Bingham Canyon Mining District in the Oquirrh Mountains, and (3) Kennecott's (on-going since 1936) mining operations. The total study area encompasses approximately 200 sq mi, most of which is underlain by valley floor alluvium and lake bed deposits. Annual water quality sampling includes sampling at least once from each of Kennecott's 51 monitor wells, 30 surface water sites, and 64 private water wells, and comprehensive water quality analysis (approximately 38 parameters). The major preliminary conclusions are that: (1) mining has caused degradation of water quality, in at least localized areas; (2) water quality degradation in the study area probably would not constrain the population and employment forecasts for the 1985-2010 period; and (3) while impacts on biota could occur due to potential toxicological effects of water pollution, the impacts would be slight due to the small area likely to be affected and the lack of threatened or endangered species. More work needs to be done to support these preliminary conclusions for the final Environmental Impact Statement. The most important element to be completed is the five-year hydrologic study, which will fill data gasps and allow estimates and projections of the impact of Kennecott and other historical and current activities on water quality. The second important element is a cost analysis of alternative water supplies. These studies, when combined with the results of ongoing USGS studies of sustainable yield of the groundwater resource, will permit accurate estimation of the social costs of water quality degradation. (Lantz-PTT)
W87-06851

MANUAL FOR HIGHWAY STORM WATER PUMPING STATIONS: VOLUME 2,
Lever (William F.) and Associates, Long Beach, CA.
For primary bibliographic entry see Field 8C.
W87-06942

WETLANDS INVESTIGATIONS ON AKERS RANCH IN BIG VALLEY, CALIFORNIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2C.
W87-07034

USE OF A GEOGRAPHIC INFORMATION SYSTEM FOR STORM RUNOFF PREDICTION FROM SMALL URBAN WATERSHEDS,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 7C.
W87-07082

STATUS AND TRENDS OF FRESHWATER WETLANDS IN THE COAL-MINING REGION OF PENNSYLVANIA, USA,
Pennsylvania State Univ., University Park. School of Forest Resources.
R. P. Brooks, and J. B. Hill.
Environmental Management EMNGDC, Vol. 11, No. 1, p 29-34, January 1987. 1 fig, 4 tab, 21 ref.

Descriptors: *Environmental effects, *Coal mining, *Wetlands, *Pennsylvania, Hydrology, Regional analysis, Land management.

The impact of surface mining for coal on the nature and extent of freshwater wetlands was assessed on 73,200 ha in western Pennsylvania. The influence of mining on wetlands was not uniform across physiographic regions, varying with regional differences in hydrology and soils. Overall, mined lands supported 18% more palustrine wetlands than unmined lands, primarily because of a 270% gain in permanent, open-water wetlands on mined lands in the glaciated region. Open-water wetlands declined on mined lands in unglaciated regions owing to unfavorable hydrologic conditions. The number and size of emergent wetlands declined as a result of mining. Mined lands supported 81% fewer riverine wetlands than unmined lands. This was caused primarily by avoidance of lands containing streams and secondarily by a 10% reduction in replacement of riverine wetlands during reclamation. Land managers need to develop land use policies that maximize the ecological and social benefits that can be derived from developing diverse wetland communities on mined lands. (Author's abstract)
W87-07083

EXTERNAL THREATS: THE DILEMMA OF RESOURCE MANAGEMENT ON THE COLORADO RIVER IN GRAND CANYON NATIONAL PARK, USA,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 6G.
W87-07086

INDIA'S BACKWATER HIGHWAYS,
For primary bibliographic entry see Field 4B.
W87-07135

SOME EFFECTS OF AFFORESTATION ON STREAMFLOW IN THE WESTERN CAPE PROVINCE, SOUTH AFRICA,
Jonkershoek Forest Research Station, Stellenbosch (South Africa).
D. B. van Wyk.
Water S. A. WASADV, Vol. 13, No. 1, p 31-36, January 1987. 7 fig, 5 tab, 21 ref.

Descriptors: *Stream discharge, *Reforestation, *Pine trees, Rainfall, Catchment areas, Statistical analysis, Ecological effects, South Africa.

In a multiple catchment experiment in the South Western Cape Province of South Africa, the influence of afforestation with Pinus radiata on streamflow was monitored from 1940 to 1980. Among its aims the research was intended to resolve the controversy as to whether extensive timber plantations of exotic tree species (replacing natural grass or shrubveld) affect streamflow adversely. Afforestation did result in reduced streamflow. In the case in which 98% of the catchment was afforested streamflow decreased by 313 mm from an initial 663 mm to an average of 350 mm/a over a period between 12 and 32 years after afforestation. Streamflow stabilized at this level. In the catchment with 57% afforestation, streamflow declined by 200 mm/a from an initial 593 mm/a over the period 16 to 40 years after afforestation, and streamflow stabilized at about 20 years. Percentage of area afforested, total biomass and rainfall appear to have influenced the magnitude of streamflow reduction. (Airone-PTT)
W87-07152

GREENHOUSE EFFECT, SEA LEVEL RISE, AND COASTAL DRAINAGE SYSTEMS,
Environmental Protection Agency, Washington, DC.
J. G. Titus, C. Y. Kuo, M. J. Gibbs, T. B. LaRoche, and M. K. Webb.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 216-227, March 1987. 2 tab, 25 ref.

Descriptors: *Air pollution effects, *Climatic effects, *Coastal waters, *Sea level, *Carbon dioxide, Drainage systems, Watersheds, Case studies, Economic aspects, Costs, Climates.

Increasing concentrations of carbon dioxide and other gases are expected to warm the earth several degrees in the next century, which would raise sea level a few feet and alter precipitation patterns. Both of these changes would have major impacts on the operation of coastal drainage systems. However, because sea level rise and climate change resulting from the greenhouse effect are still uncertain, most planners and engineers are ignoring the potential implications. Case studies of the potential impact on watersheds in Charleston, South Carolina, and Fort Walton Beach, Florida, suggest that the cost of designing a new system to accommodate a rise in sea level will sometimes be small compared with the retrofit cost that may ultimately be necessary if new systems are not designed for a rise. Rather than ignore the greenhouse effect until its consequences are firmly established, engineers and planners should evaluate whether it would be worthwhile to insure that new systems are not vulnerable to the risks of climate change and sea level rise. (Author's abstract)
W87-07196

VALIDATION OF SWRRB-SIMULATOR FOR WATER RESOURCES IN RURAL BASINS,
Agricultural Research Service, Temple, TX.
For primary bibliographic entry see Field 6B.
W87-07198

IMPACT OF CALCIUM MAGNESIUM ACETATE ROAD DEICER ON POTW OPERATION,
A. J. Rabideau, A. S. Weber, and M. R. Matsumoto.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 311-315, March 1987. 1 fig, 7 ref.

Descriptors: *Deicing salts, *Wastewater treatment, *Calcium magnesium acetate, *Roadways, Water pollution effects, Buffalo, Environmental effects.

The increased use of deicing salts in the United States over the last 20 yrs has caused a number of environmental problems. Damage attributable to sodium and calcium chloride use includes deterioration of pavement; corrosion of steel in bridge members, highway appurtenances, and automobiles; and negative impacts on roadside vegetation, soil chemistry, aquatic ecology, wildlife, and domestic water supplies. The Federal Highway Administration (FHWA) initiated research in the mid-1970s to investigate possible alternatives to the use of conventional sodium and calcium chloride road deicers. In 1980, the Bjorksten Research Laboratories identified calcium and magnesium acetate (CMA) as a potentially suitable, noncorrosive road deicer. Subsequent research on CMA has focused on three areas: environmental acceptability; development of manufacturing technologies; and technical evaluations of CMA's deicing ability, corrosiveness, and cost. From this simplified analysis it can be concluded that partial or complete substitution of CMA for conventional road salt in the Buffalo area would have a significant impact on POTW operation because of increased organic loadings. Increased organic loadings are likely to result in increased aeration, nutrient addition, and additional sludge handling capabilities. The severity of this impact would depend upon the extent that EMA was substituted for salt, weather conditions, and the ability of the POTW to react to transient loading surges. Such an impact must be considered to more fully assess the environmental impacts associated with CMA use as a road deicer in urban areas served by combined sewers. (Alexander-PTT)
W87-07203

EFFECTS OF WATER LEVEL FLUCTUATIONS ON GREAT LAKES COASTAL MARSHES,
Michigan State Univ., East Lansing. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-07432

CHARACTERISTICS OF PROVINCIALLY SIGNIFICANT WETLANDS AS ASSESSED BY THE ONTARIO WETLAND EVALUATION SYSTEM,
Ontario Ministry of Natural Resources, Toronto. Wildlife Branch.
For primary bibliographic entry see Field 2H.
W87-07443

WETLAND THREATS AND LOSSES IN LAKE ST. CLAIR,
Canadian Wildlife Service, London (Ontario).
For primary bibliographic entry see Field 2H.
W87-07444

HUMAN INTERFERENCE WITH NATURAL WATER LEVEL REGIMES IN THE CONTEXT OF OTHER CULTURAL STRESSES ON GREAT LAKES WETLANDS,
Federation of Ontario Naturalists, Don Mills.
For primary bibliographic entry see Field 2H.
W87-07445

REFORESTATION AND THE REDUCTION OF WATER YIELD ON THE SOUTHERN PIEDMONT SINCE CIRCA 1940,
California Univ., Los Angeles. Dept. of Geography.
S. W. Trimble, F. H. Weirich, and B. L. Hoag.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 425-437, March 1987. 8 fig, 4 tab, 21 ref.

Descriptors: *Model studies, *Streamflow, *Reforestation, *Water yield, *Southern Piedmont, Croplands, Regression analysis, River basins, Forests, Planning, Prediction.

The southern Piedmont has undergone extensive cropland reversion during the twentieth century with row crops being replaced by forest and pasture. Ten contiguous river basins with a total area of 54,020 sq Km had 10 to 28% of their respective areas reforested during the period 1919-1967. During the same period, water yield decreased 3 to 10 cm according to both regression and double-mass analysis. These reductions in water yield constituted a 4 to 21% decrease in annual stream discharge and were statistically significant for a majority of the basins. The reduction of water yields by forests tends to be greater for dry years than for wet years. There was little or no relation between the degree of reforestation and reductions of water yield at the scale of this study, but when the data are included with the universe of data, the variance of the data from the overall model is much less than in the universal set. The inclusion of the results extends the range and predictive power of the universal model, giving it greater utility for water yield planning. (Author's abstract)
W87-07473

POTENTIAL URBAN EFFECTS ON PRECIPITATION IN THE WINTER AND TRANSITION SEASONS AT ST. LOUIS, MISSOURI,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
F. A. Huff, and S. A. Changnon.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1887-1907, December 1986. 16 fig, 9 tab, 14 ref. NSF Grant ATM83-05502.

Descriptors: *Weather data collections, *Climatology, *Seasonal variation, *Urban hydrology, *Rainfall, *Urban areas, Saint Louis, Missouri, Topography, Snowfall, Rural areas, METROMEX, Convection, Networks.

Two datasets were used to investigate the potential presence of urban-related precipitation anomalies in the fall, winter and spring seasons at St. Louis, Missouri, and to ascertain under what conditions anomalies occurred-if indeed they did occur. The 1971-75 METROMEX dense raingage network data were used along with 1941-80 data from NWS stations in the area. Spatial and temporal analyses of seasonal precipitation showed the reality of urban-related influences northeast of St. Louis in

all seasons, plus urban-related increases to the east and southeast in winter and fall. The maximum alterations in precipitation were northeast of St. Louis with increases of 14% in spring, 5% in winter, and 7% in fall when averaged over the 40-yr sampling period. Topographic effects that increased rainfall, particularly in the winter and fall, were quite evident in the hill and bluff areas southwest and southeast of St. Louis. Studies of snowstorms during 1971-75 revealed 5% to 10% less snowfall over the city than over adjacent rural areas. Only 10% to 15% of the rain events related to areas of urban increases were altered in each season, and in most cases, they occurred with well-organized precipitation systems having convection. This agrees with the METROMEX summer findings. Good agreement between the precipitation patterns of METROMEX and climate network stations suggest that future studies of urban influences on winter and transition season precipitation can be based on the less dense climatic network of NWS. (See also W87-07513) (Author's abstract)
W87-07507

URBAN-RELATED NOCTURNAL RAINFALL ANOMALY AT ST. LOUIS,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 2B.
W87-07513

4D. Watershed Protection

NORTHWEST RANGELAND SEDIMENT YIELD ANALYSIS BY THE MUSLE,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2J.
W87-06656

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

BIOCHEMICAL OXYGEN DEMAND OF AGRICULTURAL RUNOFF,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
J. D. Schrieber, and E. E. Neumaier.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 6-10, January-March 1987. 3 fig, 5 tab, 23 ref.

Descriptors: *Runoff, *Agricultural runoff, *Biochemical oxygen demand, *Tillage effects, *Sediments, Soybeans, Wheat, Crop residues, Surface cover, Equations, Nutrients.

Many of the minimum and no-till conservation management practices utilize crop residues in some manner to reduce both sediment and sediment associated nutrient yields. However, recent research indicates that some soluble chemical concentrations are higher in runoff from no-till practices, especially when crop residues are left on the soil surface. Using an electrolytic respirometer, agricultural runoff from seven crop and tillage practices was studied to determine the 5-d biochemical oxygen demand (BOD5). Mean BOD5 concentrations for the practices ranged from 10 to 25 mg O2/L as compared to 4 to 56 mg O2/L for individual storm events. In general, there was no difference in BOD5 concentrations between conventional and no-till practices. Biochemical oxygen demand-time relationships were found to best fit a first-order reaction equation. The aqueous phase was the dominant source of BOD5, amounting to 64 + or - 17% (1 SD) of the total BOD5 in runoff from no-till soybeans, double-cropped with winter wheat (Triticum aestivum L.). However, additional data indicate that conventional tillage practices, producing higher sediment concentrations, may result in a greater proportion of the BOD associated with the sediment phase. (Alexander-PTT)
W87-06718

CHARACTERIZATION OF IRON AND ZINC IN ALBUQUERQUE SEWAGE SLUDGE,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
K. Knudtsen, and G. A. O'Connor.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 85-90, January-March 1987. 2 fig, 3 tab, 28 ref. DOE Contract DE-AC04-83AL21776.

Descriptors: *Pollutant identification, *Sludge, *Iron, *Zinc, *Albuquerque, Anaerobic digestion, Speciation, Heavy metals, Extraction, Chromatography.

Chemical forms of Fe and Zn present in anaerobically digested sewage sludge from Albuquerque, NM were identified and quantified. Water-soluble Fe and Zn were speciated based on charge and stability of metal complexes, and on their degree of association with soluble organics. Chemical forms of Fe and Zn present in the solid phase of the sludge were characterized with a sequential extraction procedure. Soluble Fe was predominantly present as negatively charged slowly labile organic complexes of molecular weights > 1000 daltons. Zinc was associated with negative and neutral species that were very or moderately labile, according to the techniques used. The contribution of soluble organics to the chemistry of Fe and Zn was evaluated using gel chromatography. Iron was associated with a larger portion of sludge organics and with larger molecular weight fractions than Zn complexes. The percentage of total sludge Fe and Zn found in readily soluble forms was very small (<1%). The amounts may nevertheless represent significant pools of metal forms available for plants. Zinc was found in larger concentrations than Fe in the potentially more labile, organic, and carbonate fractions of the sludge. The Albuquerque sludge is an excellent source of Fe and Zn to plants because it contains readily soluble forms of these metals that may be maintained in soil solution through organic complexation. (Author's abstract)
W87-06729

DIFFERENTIAL-PULSE POLAROGRAPHIC DETERMINATION OF SELENIUM SPECIES IN CONTAMINATED WATERS,
Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Analytical Chemistry Section.
G. E. Batley.
Analytica Chimica Acta ACACAM, Vol. 187, p 109-116, September 1986. 4 fig, 2 tab, 17 ref.

Descriptors: *Polarography, *Water analysis, *Analytical methods, *Selenium, *Speciation, Adsorption, Heavy metals, Chromatography, Ion-exchange, Sample preparation, Detection limits.

The polarographic behavior of selenium has been the subject of considerable discussion for many years. Recent increased awareness of the biological role of selenium has produced a revival of interest in methods for the determination of selenium and its speciation at trace concentrations. Polarographic techniques can be used to advantage for speciation because only selenium(IV) is electroactive. Selenium(IV), in the concentration range 2-100 microgram/L in contaminated waters, is determined by using the sensitive adsorption-controlled peak obtained by differential pulse polarography in dilute acid solution. Interfering heavy metals are removed on Chelex-100 resin. Selenium(IV) is not electroactive but can be determined after photolytic reduction in the absence of oxygen. Anion-exchange preconcentration is necessary if the total selenium is below the detection limit of 2 microgram/L. (Alexander-PTT)
W87-06730

DIRECT DETERMINATION OF CADMIUM IN NATURAL WATERS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITHOUT MATRIX MODIFICATION,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
K. R. Lum, and M. Callaghan.
Analytica Chimica Acta ACACAM, Vol. 187, p 157-162, September 1986. 1 fig, 1 tab, 8 ref.

Descriptors: *Cadmium, *Analytical methods, *Measuring instruments, *Natural waters, *Atomic absorption spectrometry, Spectral analysis, Heavy metals, Detection limits, Performance evaluation, Sample preparation.

Cadmium and its compounds are subject to regulatory activity because of their adverse environmental and health effects. In aquatic systems, water quality objectives have been established on the basis of protection of sensitive biological species. Rapid, precise and accurate methods for the determination of cadmium in coastal (marine) and fresh waters are thus needed. A procedure for the determination of cadmium in fresh, coastal and estuarine waters by polarized Zeeman-effect graphite-furnace atomic absorption spectrometry was validated by using lake waters and seawater. The limit of detection for freshwaters is <2 ng/L cadmium. Undiluted seawater can be analyzed directly without the addition of matrix modifiers with the aid of a stabilized temperature platform. The instrument is calibrated with diluted NBS SEM 1643a (Trace Elements in Water). Analytical performance was tested extensively with fresh and brackish water samples and procedures were worked out to ensure that a high degree of accuracy is achieved consistently. (Alexander-PTT)
W87-06731

IDENTIFICATION OF HYDROLYSIS PRODUCTS OF ALUMINIUM IN NATURAL WATERS: PART 1. N-DIMENSIONAL CALIBRATION OF AL/F KINETIC PATHWAYS,
Goettingen Univ. (Germany, F.R.).
J. Ares.
Analytica Chimica Acta ACACAM, Vol. 187, p 181-194, September 1986. 8 fig, 2 tab, 8 ref.

Descriptors: *Model studies, *Pollutant identification, *Chemical reactions, *Hydrolysis, *Aluminum, *Natural waters, *Kinetics, *Fluorides, Statistics, Complexation, Speciation, Distribution, Electrodes, Solutions, Regression analysis.

The kinetics of complexation of aluminum(III) with fluoride in dilute solutions were studied by means of a fluoride-selective electrode. A statistical treatment was used to model some measurable characteristics of the reaction path in terms of the underlying mass-balance constraints involved in the complexation reaction. Two basic types of kinetic pathways were identified and related to the distribution of hydrolyzed aluminum species in the solution, and to the prevalence of various coordination mechanisms. The results indicate that fluoride reacts simultaneously with different hydrolyzed aluminum species at different rates at the experimental concentrations used. A combination of stepwise regression techniques and least-squares correlation was used to derive a matrix of relative reaction-rate coefficients characterizing fitting surfaces of the complexation paths. These can be used to describe the distribution of reactive aluminum species in unknown solutions. (See also W87-06733) (Author's abstract)
W87-06732

IDENTIFICATION OF HYDROLYSIS PRODUCTS OF ALUMINIUM IN NATURAL WATERS: PART 2. ALSPEC, A COMPUTERIZED PROCEDURE FOR QUANTIFYING EQUILIBRIA WITH INORGANIC AND ORGANIC LIGANDS,
Goettingen Univ. (Germany, F.R.).
J. Ares.
Analytica Chimica Acta ACACAM, Vol. 187, p 195-211, September 1986. 8 fig, 6 tab, 21 ref.

Descriptors: *Computer programs, *ALSPEC, *Pollutant identification, *Chemical reactions, *Hydrolysis, *Aluminum, *Natural waters, *Kinetics, *Fluorides, Complexation, Speciation, Distribution, Electrodes, Solutions, Potentiometry, Ligands, Colloids.

Calibration surfaces describing the kinetics of Al/F complex formation were used to develop a linear programming procedure with which the distribution of aluminum species in various solutions is

investigated. Samples tested include prepared solutions containing different levels and ratios of hydroxide, fluoride, sulfate, citrate and a fulvic acid, and solutions from soil water extracts and lysimeter water. The calibration surfaces are robust for describing all the cases tested. Results obtained with fulvic acid solutions agree with reported data on aluminum/fulvic acid complexes. The results obtained with soil solutions are internally consistent and in line with the expected behavior of humic materials. A software package is described for combining potentiometry with a fluoride-selective electrode with linear programming routines in order to solve problems of aluminum speciation in solutions containing ligands which have unknown thermodynamic characteristics and may be colloidal polyelectrolytes. (See also W87-06732) (Author's abstract)
W87-06733

DETERMINATION OF TRACE AMOUNTS OF VANADIUM(IV) AND (V) IN WATER BY ENERGY-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY COMBINED WITH PRECONCENTRATION AND SEPARATION,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-06734

FLUORIDE ION-SELECTIVE ELECTRODE IN FLOW INJECTION ANALYSIS: PART 3. APPLICATIONS,
Hahn-Meitner-Inst. fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.).
W. Frenzel, and P. Bratter.
Analytica Chimica Acta ACACAM, Vol. 188, p 151-164, October 1986. 6 fig, 5 tab, 42 ref.

Descriptors: *Fluorides, *Analytical methods, *Flow injection analysis, *Electrodes, *Measuring instruments, Detection limits, Buffers, Drinking water, Urine, Ions, Sample preparation.

Flow-injection potentiometry with a combination fluoride-selective electrode was used to determine fluoride in tap water, beverages and urine. Excellent sensitively (down to 1 microgram/L) and long-term stability was obtained, with a sample throughput of 30-40/h, based on triplicate injections at 120/h. The commonly used buffer TISAB-III is unsuitable for the analysis of undiluted tea and urine samples. The application of a modified citrate-containing TISAB overcomes interferences caused by high natural ionic strength and avoids complexation of fluoride. Recoveries after spiking tap water, tea and urine with fluoride concentrations ranging from 0.01 to 1 mg/L were in the range 91-106%. The equipment used provides a flexible system allowing fast changes between different buffers and carrier streams depending on the samples presented. (Author's abstract)
W87-06735

DETERMINATION OF ALUMINIUM IN SEA-WATER AND FRESHWATER BY CATHODIC STRIPPING VOLTAMMETRY,
Liverpool Univ. (England). Dept. of Oceanography.
C. M. G. Van Den Berg, K. Murphy, and J. P. Riley.
Analytica Chimica Acta ACACAM, Vol. 188, p 177-185, October 1986. 6 fig, 12 ref.

Descriptors: *Aluminum, *Analytical methods, *Seawater, *Cathodic stripping voltammetry, *Pollutant identification, Sample preparation, Electrodes, Complexation, Adsorption, Detection limits, Ions.

Dissolved aluminum in seawater and freshwater was determined by cathodic stripping voltammetry (c.s.v.) preceded by adsorptive collection of complex ions with 1,2-dihydroxyanthraquinone-3-sulphonic acid (DASA) on the hanging mercury drop electrode. Complexation of aluminum by DASA is rapid and no waiting period or heating of the sample is required. Optimal conditions are a DASA concentration of .00001 M, a solution pH of 7.1-7.3 and an adsorption potential of -0.9 V; the c.s.v. scan is done in the differential-pulse mode. The limit of detection is 1 nM aluminum for an adsorption time of 45 s. The total time needed, including 5-min deaeration and standard addition, is 10-15 min per sample. No serious interferences were found; u.v. irradiation is recommended for samples containing high levels of organic materials. (Author's abstract)
W87-06736

EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF ZINC IN COAL FLY ASH AND POND SEDIMENTS WITH 2-(2-(3,5-DIBROMOPYRIDYL)AZO)-5-DIMETHYLAMINOBENZOIC ACID,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
T. Katami, T. Hayakawa, M. Furukawa, S. Shibata, and T. Hara.
Analytica Chimica Acta ACACAM, Vol. 188, p 289-294, October 1986. 2 fig, 3 tab, 4 ref.

Descriptors: *Analytical methods, *Extraction, *Spectrophotometry, *Zinc, *Sediments, Complexation, Sample preparation, Spectral analysis, Absorption, Heavy metals, Coal fly ash, Pond sediments, Performance evaluation.

An extraction-spectrophotometric method is described for the determination of traces of zinc with 2-(2-(3,5-dibromopyridyl)azo)-5-dimethylaminobenzoic acid. The reagent forms a stable, blue 1:2 zinc/reagent complex that can be extracted into chloroform. The apparent molar absorptivity of the zinc(II) complex is 126000 L/mol/cm at 610 nm in chloroform. The reagent is relatively selective; interferences from cobalt, copper and nickel can be masked with dimethylglyoxime and aluminum and iron with a mixture of sodium fluoride and triethanolamine. The method was applied to the determination of zinc in pond sediments with good precision and accuracy. (Author's abstract)
W87-06737

DETERMINATION OF SELECTED TRACE METALS IN SCALLOPS BY FLAME ATOMIC ABSORPTION SPECTROMETRY AFTER REMOVAL OF SODIUM ON HYDRATED ANTIMONY PENTOXIDE,
Brandon Univ. (Manitoba). Dept. of Chemistry.
S. K. Nyarku, M. Delmage, and K. Szturm.
Analytica Chimica Acta ACACAM, Vol. 188, p 307-310, October 1986. 1 tab, 7 ref.

Descriptors: *Trace metals, *Scallops, *Atomic absorption spectrometry, *Analytical methods, *Sodium, Detection limits, Hydrated antimony pentoxide, Sample preparation, Spectral analysis, Heavy metals, Performance evaluation.

Marine organisms are known to contain relatively high concentrations of trace metals in some organs. These concentrations are much greater than those found in the marine environment. Hydrated antimony pentoxide (HAP) was used to obtain improved detection limits in a project designed to follow the seasonal changes in the trace metal concentrations in the scallop species, Plactopecten magellanicus, which is common in the waters off the coast of Newfoundland. This use of HAP in the determination of trace elements in scallops is effective in removing interferences of sodium and improves the determination of many elements by atomic absorption spectrometry. It is thus possible to determine whether there are significant correlations between elements other than nickel and cobalt in the species. The concentrations of Cd, Cr, Co, Cu, Au, Fe, Pb, Mn, Hg, Ni, Ag and Zn were determined in the samples and in a standard reference material. This method yields improved detection limits with simple apparatus. (Alexander-PTT)
W87-06738

DETERMINATION OF MICROGRAM AMOUNTS OF ARSENIC IN GEOLOGICAL MATERIALS AND WATERS BY WAVELENGTH-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY,
Saint Mary's Univ., Halifax (Nova Scotia). Dept. of Chemistry.
C. M. Hemens, and C. M. Elson.
Analytica Chimica Acta ACACAM, Vol. 188, p 311-315, October 1986. 1 tab, 11 ref.

Descriptors: *Arsenic, *X-ray fluorescence spectrometry, *Sample preparation, *Analytical methods, Detection limits, Heavy metals, Spectral analysis, Coprecipitation, Seawater, Selenium.

The arsenic content of geological materials and natural waters usually cannot be quantified directly by instrumental techniques because of either interferences or the insensitivity of the instruments. Hence, isolation and preconcentration steps form a vital part of the overall determination. Microgram quantities of arsenic were determined in geological materials or water samples by coprecipitating the analyte with elemental selenium and using x-ray fluorescence directly on the precipitate. The coprecipitation step removes elemental interferences and converts the sample to a thin film. The selenium matrix enhances the fluorescent emission of arsenic which enables 0.2 microgram/gram to be determined. The method was applied to a series of geological reference materials and a seawater sample. (Alexander-PTT)
W87-06739

ASSESSMENT OF REFERENCE ELECTRODES FOR USE IN DETERMINING THE PH OF ACIDIC, POORLY-BUFFERED WATERS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 7B.
W87-06747

VIRUS SURVIVAL ON VEGETABLES SPRAY-IRRIGATED WITH WASTEWATER,
Fairfield Hospital for Communicable Diseases (Australia). Virus Lab.
For primary bibliographic entry see Field 5B.
W87-06755

BIOACCUMULATION OF ZINC IN TWO FRESHWATER ORGANISMS (DAPHNIA MAGNA, CRUSTACEA AND BRACHYDANIO RERIO, PISCES),
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Biologie 5.
For primary bibliographic entry see Field 5B.
W87-06760

DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AQUEOUS SYSTEMS BY MEMBRANE INLET MASS SPECTROMETRY,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
B. J. Harland, P. J. D. Nicholson, and E. Gillings.
Water Research WATRAG, Vol. 21, No. 1, p 107-113, January 1987. 7 fig, 3 tab, 18 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Mass spectrometry, *Analytical methods, *Measuring instruments, Membranes, Inlets, Detection limits, Sensitivity, Solubility, Prediction, Physico-chemical properties, Temperature.

The determination of organic compounds at trace levels in aqueous samples is of considerable importance in many fields, e.g. environmental, medical, process applications. Many techniques are available for their measurement, but that of mass spectrometry is particularly useful because of its specificity. The potential of a silicone rubber membrane, a simple mass spectrometry inlet system, for the direct determination of volatile organic compounds in aqueous samples was re-examined. Greatest sensitivity (microgram/L level) was found for volatile insoluble compounds, while decrease in volatility or increase in solubility, or both, appeared to reduce sensitivity. A novel correlation was demonstrated between the air-water partition coefficient for a compound and the molar enrichment factor for its transfer through the silicone membrane from aqueous solution. This rela-

tionship allows the prediction of the likely sensitivity of a compound to measurement by this technique from its physico-chemical properties. Some evidence was also obtained that elevated sample temperatures extend the range of compounds which can be readily determined. (Alexander-PTT)
W87-06761

COMPARING GEL PERMEATION CHROMATOGRAPHY AND ULTRAFILTRATION FOR THE MOLECULAR WEIGHT CHARACTERIZATION OF AQUATIC ORGANIC MATTER,
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, M. R. Collins, C. J. Kuo, and P. H. King.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 43-49, January 1987. 6 fig, 2 tab, 26 ref.

Descriptors: *Pollutant identification, *Organic matter, *Data acquisition, *Gel permeation chromatography, *Chromatography, *Ultrafiltration, *Analytical techniques, Testing procedures, Water treatment, Comparison studies, Filtration, Molecular weight determination, Raw water, Dissolved solids, Hydrogen ion concentration.

Gel permeation chromatography (GPC) and Ultrafiltration (UF), both relatively inexpensive analytical techniques requiring moderate levels of analyst expertise, are potential tools for monitoring the presence of aquatic organic matter and humic substances in raw water sources as well as the removal of organic constituents during water treatment. The two methods provided somewhat different trends in the relative molecular weight distribution of dissolved organic matter in various water sources. The GPC method generally indicated a higher molecular weight than the UF method for a given source. Moreover, the GPC method was affected more significantly by pH conditions. (Author's abstract)
W87-06768

DEVELOPING HALOFORM FORMATION POTENTIAL TESTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-06769

RAPID DETERMINATION OF METHYL MERCURY IN FISH AND SHELLFISH: METHOD DEVELOPMENT,
Food and Drug Administration, Washington, DC. Contaminants Chemistry Div.
S. C. Hight, and M. T. Corcoran.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 70, No. 1, p 24-30, January-February 1987. 1 fig, 5 tab, 14 ref.

Descriptors: *Pollutant identification, *Mercury, *Shellfish, *Analytical methods, *Sample preparation, *Methyl mercury, Gas chromatography, Detection limits, Swordfish, Shark, Tuna, Shrimp, Fish, Clams, Mollusks, Oysters, Crustaceans, Comparison studies, Heavy metals, Performance evaluation, Tissue analysis.

The AOAC official first action method for methyl mercury in fish and shellfish was modified to provide more rapid determination. Methyl mercury is isolated from homogenized, acetone-washed tissue by addition of HCl and extraction by toluene of the methyl mercuric chloride produced. The extract is analyzed by electron capture gas chromatography (GC) on 5% DEGS-PS treated with mercuric chloride solution. The quantitation limit of the method is 0.25 micrograms Hg/gram. Swordfish, shark, tuna, shrimp, clams, oysters, and NBS Research Material-50 (tuna) were analyzed for methyl mercury by the AOAC official first action method. All products also were analyzed by the modified method and the AOAC official method for total mercury. In addition, selected extracts obtained with the modified method were analyzed by GC with Hg-selective, microwave-induced helium plasma detection. There was no significant difference between the results for the various methods. Essentially all the Hg present (determined as total Hg) was in the organic form. Coefficients of variation from the analyses by the modified method ranged from 1 to 7% for fish and shellfish containing methyl mercury at levels of 0.50-2.3 micrograms Hg/gram. The overall average recovery was 100.5%. (Author's abstract)
W87-06788

EXTRACTION AND DETERMINATION BY GAS CHROMATOGRAPHY OF S,S,S-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) IN FISH AND WATER,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. Habig, A. Nomeir, R. T. DiGiulio, and M. B. Abou-Donia.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 70, No. 1, p 103-106, January-February 1987. 4 fig, 3 tab, 14 ref. National Toxicology Training Program Grant 32ES 07031.

Descriptors: *Pollutant identification, *Phosphorus compounds, *Analytical methods, *Tri-n-butyl phosphorotrithioate, *Sample preparation, *Phosphate pesticides, *Water analysis, *Gas chromatography, Water pollution, Defoliants, Agricultural chemicals, Fish,Detection limits, Toxins, Tissue analysis, Pesticides.

S,S,S-Tri-n-butyl phosphorotrithioate (DEF) is commonly used as a cotton defoliant in California and southeastern United States and was shown to be toxic to fish at low concentrations under acute exposure. A simple, low-cost, rapid method for the extraction and cleanup of DEF from fish tissues and water samples was developed. The method combines extraction and cleanup in one step. The basis of the method is passing water samples or aqueous tissue homogenates containing DEF through a C-18 disposable cartridge. DEF is eluted from the cartridge by acetone or ethyl acetate. The eluates are analyzed by gas chromatography using a thermionic-specific detector. The method detects levels as low as 100 part per trillion in water samples; recovery efficiency from spiked fish tissues was greater than 95%. In addition, detectable levels of DEF were recovered from liver, brain and muscle tissue of fish exposed to this compound. The method has a potential for use with other pesticides. (Wood-PTT)
W87-06789

SENSITIVE COLORIMETRIC METHOD FOR THE QUANTITATION OF SELENITE IN SOIL SOLUTIONS AND NATURAL WATERS,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
K. M. Holtzclaw, R. H. Neal, G. Sposito, and S. J. Traina.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 75-78, January-February 1987. 1 fig, 4 tab, 17 ref.

Descriptors: *Analytical methods, *Colorimetric methods, *Selenite, *Soil solutions, *Natural waters, *Selenium, Complexes, Sample preparation, Ions, Performance evaluation.

A sensitive colorimetric method for the quantitation of selenite in aqueous solution at concentrations between 0.15 and 30 micromol/kg was developed. The method is based on the formation of a colored complex between selenite and 2,3-diaminonapthalene (DAN) and is selective for selenite in selenite-selenate mixtures. The yellow color of the complex is stable for at least 48 h and there appear to be no interference effects from selenate, sulfate, and other normal soil solution ionic constituents at moderate to high concentrations. Because the method is specific for selenite, it can be combined with acid digestion and hydrolysis to quantitate total Se and to speciate Se in soil solutions containing both selenite and selenate. (Author's abstract)
W87-06803

THREE-MINUTE ANALYSIS OF CHLORIDE, NITRATE, AND SULFATE BY SINGLE COLUMN ANION CHROMATOGRAPHY,
Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
P. Barak, and Y. Chen.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 257-258, January-February 1987. 2 fig, 1 tab, 5 ref.

Descriptors: *Analytical methods, *Measuring instruments, *Anion chromatography, *Chromatography, *Chlorides, *Nitrates, *Sulfates, Anions, Ions, Detection limits, Soil solution, Groundwater, Performance evaluation.

Accepted techniques of single column ion chromatography of inorganic anions were extended to separation of chloride, nitrate, and sulfate using 15 mM phthalic acid as an eluent, permitting reduction of column length to 30 mm and thereby reducing analysis time to three min. Using a 50 micro-L sample loop, detection limits were 0.05 mmol sub c/L and coefficient of variation values ranged from 0.8 to 1.7% using peak height measurements and 0.8 to 8.1% using peak area measurements. This configuration is appropriate for routine analysis of soil water extracts and ground water. (Author's abstract)
W87-06810

ANALYTICAL CHEMISTRY OF PCBS,
Midwest Research Inst., Kansas City, MO.
M. D. Erickson.
Butterworth Publishers, Boston, Massachusetts. 1986. 508 p.

Descriptors: *Pollutant identification, *Polychlorinated biphenyls, *Chemical analysis, *Fate of pollutants, Physical properties, Chemical properties, Path of pollutants, Water pollution treatment, Sampling, Bibliographies.

Presented is a comprehensive review of the analytical chemistry of polychlorinated biphenyls (PCBs). It is part history, part annotated bibliography, part comparison and part guidance. The book contains ten chapters. Following an introductory chapter, Chapter 2 reviews the physical, chemical, commercial, environmental, and biological properties of PCBs. Chapter 3 discusses the available written procedures (standard methods, etc.) which may be used directly by analysts. The next six chapters discuss the discrete steps of analysis: sampling, extraction, cleanup, determination, data reduction, and quality assurance. Chapter 10 discusses collaborative testing, which is the ultimate step in a method validation. A bibliography is presented. Five appendices present ancillary material on PCB nomenclature and physical properties, composition of commercial mixtures, mass spectra characteristics, and PGC/ECD chromatograms. The final appendix (E) is a glossary of the specialized terms and abbreviations used throughout this book. (Lantz-PTT)
W87-06848

ANALYSIS OF WATERS ASSOCIATED WITH ALTERNATIVE FUEL PRODUCTION.
American Society for Testing and Materials, Philadelphia, PA.
A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. Edited by L. P. Jackson, and C. C. Wright.

Descriptors: *Water analysis, *Symposium, *Pollutant identification, Fuel, Industrial wastes, Water pollution prevention, Water pollution sources.

The objective of this symposium was to allow the technical community and members of the American Society for Testing and Materials, in particular, to become acquainted with the nature of the waters and attendant analytical problems arising from the production of fossil fuels from little used natural resources and new technologies. It was intended that this gathering would serve as a stimulus for the updating of current methods of testing or for the development of new procedures to satisfy the needs of those charged with providing new sources of energy and to satisfy the regulatory agencies, which must assess the potential impacts of these new technologies on society. The sixteen

papers presented meet these stated objectives and serve to acquaint the reader concerned with analysis of waters with a wide variety of problems and perhaps a few solutions. (See also W87-06872 thru W87-06887) (Lantz-PTT)
W87-06871

GUIDELINE CONSIDERATIONS FOR SELECTING ANALYTICAL METHODS AND FOR COST ANALYSIS ASSOCIATED WITH MONITORING WATERS ASSOCIATED WITH ALTERNATIVE FOSSIL FUEL TECHNOLOGIES,
Dalton-Dalton-Newport, Inc., Cleveland, OH.
R. G. Rolan, M. Busacca, M. J. Kangas, L. J. Mezga, and C. L. Cornett.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 3-17, 3 fig, 2 ref.

Descriptors: *Analytical methods, *Water analysis, *Guidelines, *Water quality control, *Monitoring, *Fuel, *Industrial wastewater, *Cost analysis, Chemical analysis, Physical analysis, Organic compounds, Inorganic compounds, Symposium.

Considerations for developing detailed environmental monitoring plans are described for fossil energy research, development, and demonstration facilities funded by the U.S. Department of Energy (DOE); this approach applies as well to other fossil energy technologies not currently funded by the DOE. This paper focuses on a systematic approach to technical and cost aspects of methods selection for chemical, physical, biological, and support parameters. Emphasis is placed on methods selection for inorganic and organicchemical parameters for both process and ambient waters. (Seealso W87-06871) (Author's abstract)
W87-06872

ANALYSIS OF TOSCO II OIL SHALE RETORT WATER,
ERE Systems Ltd., Arlington, VA.
F. C. Haas.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 18-27, 1 fig, 11 tab, 3 ref.

Descriptors: *Water analysis, *Sampling, *Retort water, *Oil shale, *Golden, *Colorado, *Pollutant identification, Sulfur, Cations, Anions, Trace metals, Organic compounds, Industrial wastewater, Spectral analysis, Symposium.

A sampling and analysis program for Tosco II oil shale retort water was conducted at the Tosco Corporation's 21773-kg (24-ton)/day pilot plant near Golden, Colorado. The sampling and sample storage procedures are presented along with the analyses for common ions and trace metals. The substantial amounts of organic material present were separated by pH extraction and characterized as organic acids, organic bases, neutral oils, and phenolic material. Tosco II oil shale retort water contains a mixture of inorganic salts and water soluble organic material. The major inorganic constituent is ammonium carbonate. The predominant sulfur species is sulfide. Only small amounts of the normally occurring cations and anions are present. A spark source mass spectrometry scan shows only trace amounts of various metals. The water soluble organic material is characterized as organic acids, organic bases, neutral oils, and phenolic material. There are striking differences between Tosco II retort water and in situ retort waters. The Tosco IIwater is considerably lower in total dissolved inorganic salts but higher in water soluble organic material. (See also W87-06871) (Lantz-PTT)
W87-06873

WATER ANALYSIS FOR BASELINE CHARACTERIZATION AND PROCESS DEVELOPMENT OF A MULTIMINERAL OIL SHALE PROCESS,
Superior Oil Co., Englewood, CO. Oil Shale Div.
J. A. Meredith, and D. E. Petticrew.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 28-37, 1 fig, 5 tab, 3 ref.

Descriptors: *Process water, *Oil shale, *Water analysis, *Pollutant identification, *Piceance Creek, *Colorado, Fuel, Industrial wastewater, Permits.

The Superior Oil Co. was involved in development of a multimineral process to be used on oil shale and associated minerals in the northern part of the Piceance Creek Basin in northwestern Colorado. The past sampling and analysis programs on surface and groundwater was mainly directed toward answering process concerns (quantity and quality), since the process water is to be derived from the lower aquifer. In reviewing the laws and regulations for the purpose of developing a program designed specifically to obtain the necessary permits for construction, a lack of firm requirements for baseline water quality was identified. (See also W87-06871) (Author's abstract)
W87-06874

ORGANIC AND INORGANIC ANALYSIS OF CONSTITUENTS IN WATER PRODUCED DURING IN SITU COMBUSTION EXPERIMENTS FOR THE RECOVERY OF TAR SANDS,
Department of Energy, Laramie, WY. Laramie Energy Technology Center.
F. A. Barbour, and F. D. Guffey.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 38-55, 3 fig, 10 tab, 6 ref.

Descriptors: *Sample preparation, *Process water, *Pollutant identification, *Chemical analysis, *Organic compounds, *Inorganic compounds, *Tar sands, *Vernal, *Utah, Water analysis, Gas chromatography, Mass spectrometry, Carboxylic acids, Acetic acid, Phenols, Lactones, Pyridines, Extraction, Spectral analysis.

The characterization of waters produced during in situ combustion of a tar sand deposit near Vernal, Utah, is presented. The water samples were collected during two different field experiments. Analysis of the inorganic constituents by standard methods indicated that ammounium, sulfate, and chloride were the predominant ions. Fractions of the organic material, defined as acid and base extracts, were obtained by liquid-liquid extraction using ethyl ether. Gravimetrically, the acid extracts comprised more than 70% of the extractable organic material. Identification of the components in the acid extracts was accomplished by using combined gas chromatography-mass spectroscopy (GC-MS) after methylation with diazomethane. The base extracts were found to be more complex and could not be studied directly with GC-MS. Of the major organic compounds identified, carboxylic acids, particularly acetic acids, were found to be the most abundant. Phenols, lactones, and pyridines were also identified. (See also W87-068971) (Author's abstract)
W87-06875

CONTRIBUTION OF THIOSULFATE TO CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND IN OIL SHALE PROCESS WASTEWATER,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5C.
W87-06876

MUTAGENICITY TESTING OF AQUEOUS MATERIALS FROM ALTERNATE FUEL PRODUCTION,
Oak Ridge National Lab., TN. Biology Div.
For primary bibliographic entry see Field 5C.
W87-06877

ANALYSIS OF TRACE METALS AND CYANIDE IN COMPLICATED WASTE MATRICES,
Illinois State Environmental Protection Agency, Springfield. Div. of Land Pollution Control.
W. K. El-Beck, and M. L. Miller.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 76-85, 1 fig, 1 tab, 4 ref.

Descriptors: *Sample preparation, *Analytical methods, *Trace metals, *Pollutant identification, *Wastes, *Chloroform, *Cyanide, Heavy metals, Organic compounds, Hydrocarbons, Miscibility.

The analysis for soluble heavy metals and cyanide in waste materials and other complex matrices can be assisted by the use of chloroform. It was found that the waste stream samples were not miscible in a simple acetic acid leach solution. The samples lumped, and all the samples formed globules, which sank or floated in the solution, depending on their density. The results of the analysis of the filtrate revealed heavy metal concentrations of less than 0.01 ppm. Chloroform was used in a test procedure designed to simulate codisposal of waste with municipal refuse. The addition of the chloroform to the sample solution caused the waste globules to break down. If allowed to settle, two layers formed, acetic acid solution and chloroform, waste layers. When mixed, the two layers blend, and better contact between the waste and the acetic acid solution is achieved. It can be seen from these results that the heavy metals were leached to the acid solution when chloroform was added. The values for crude oil and oil shale are relatively low, since the total metals in the sample were low. In the cases of organic paint sludge and cutting oil wastes, large amounts of leachable lead (386 and 1310 mg/L) were identified by using the chloroform procedure. Other waste samples, which were found to be nonmiscible in the acetic acid solution, were tested to determine the effect of chloroform on miscibility. While heavy metal analysis was not done, the miscibility was improved in every case. It should be noted that the chloroform layer can be readily used after leaching is completed to identify the presence of halogenated hydrocarbons and other organics in the waste. (See also W87-06871) (Lantz-PTT)
W87-06878

IDENTIFICATION OF COMPONENTS IN AQUEOUS EFFLUENTS ASSOCIATED WITH NEW COAL TECHNOLOGIES AND GEOTHERMAL ENERGY SOURCES,
Gulf South Research Inst., New Orleans, LA. Dept. of Analytical Chemistry.
J. E. Gebhart, R. M. Segasta, and L. C. Rando.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 86-94, 4 fig, 3 tab, 4 ref.
EPA Contract 68-03-2487.

Descriptors: *Water pollution sources, *Pollutant identification, *Coal, *Gasification, *Industrial wastewater, Geothermal energy, Chemical analysis, Gas chromatography, Mass spectrometry, Spectral analysis.

Aqueous effluents from a coal gasification operation and from a geothermal energy process were analyzed using established procedures. The results of the analysis for metals by spark source mass spectrometry are given. This report stresses the identification of organic compounds in the sample by combined gas chromatography-mass spectrometry and computerized spectral matching techniques. In the aqueous samples obtained from the Hoe Creek II site, near Gillette, Wyoming, prior to gasification, calcium and magnesium were the only metals found at levels higher than 10 ppm. The aqueous samples collected after gasification contained iron, potassium, sulfur, titanium, and strontium at levels higher than 10 ppm. In the aqueous samples obtained prior to gasification, only alkanes and phthalates were detected, and the total concentration of these materials was at levels less than 10 ppb. The presence of these compounds may be due to the lubricants used in drilling the sampling wells and to the polyvinyl chloride pipes through which the water was pumped during the sample collection. After gasification, the levels and the

variety of organic compounds detected in the aqueous samples increased. Only two samples were obtained from geothermal energy sources. These aqueous samples contained only a few compounds that were present at levels less than 10 ppb. (See also W87-06871) (Lantz-PTT)
W87-06879

ELEMENTAL COMPOSITION OF SIMULATED IN SITU OIL SHALE RETORT WATER,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. P. Fox.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 101-128, 3 fig, 5 tab, 21 ref. DOE Contract W-7405-ENG-48.

Descriptors: *Water pollution sources, *Process Water, *Pollutant identification, *Oil shale, *Simulation analysis, Trace elements, Chemical analysis, Heavy metals.

The abundances of 47 elements in 23 unfiltered retort waters from three simulated in situ retorts and of 17 elements in the dissolved and particulate fraction of 11 of these waters indicate that for most of the unfiltered waters, the carbon, hydrogen, nitrogen, and sulfur occur at concentrations greater than 0.1%; that aluminum, arsenic, calcium, iron, potassium, sodium, nickel, and chlorine occur at concentrations greater than 1 ppm and less than 0.1%; and that all other measured elements occur at concentrations of less than 1 ppm. The particulate fraction in these waters ranges from 203 to 2984 mg/L, and, in most waters, iron, nickel, potassium, and calcium occur at concentrations that are greater than 0.1 mg/L. (Carbon, hydrogen, nitrogen, and sulfur were not measured in the particulates). All other measured elements (titanium, vanadium, chromium, manganese, gallium, arsenic, selenium, bromine, rubidium, strontium, yttrium, mercury, and lead) typically occur at concentrations of less than 0.05 mg/L in the particulates. About 1% of the total elemental mass of potassium, arsenic, and selenium occurs in the particulates, while significantly greater than 1% of the elemental mass of iron, chromium, mercury, and nickel may be present as particulate matter. The dissolved metal content of some waters was significantly reduced during filtration by crystallization and bacterial uptake. (See also W87-06871) (Author's abstract)
W87-06881

PARAHO WATERS - CHARACTERISTICS AND ANALYSIS OF MAJOR CONSTITUENTS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
T. R. Wildeman, and S. L. Hoeffner.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 129-141, 1 fig, 3 tab, 16 ref. DOE Grant E(11-1) 4017.

Descriptors: *Process water, *Paraho, *Colorado, *Oil shale, *Water analysis, Hydrogen ion concentration, Conductivity, Alkalinity, Ammonia, Sulfur, Thiosulfates, Sample preparation, Sample storage.

Eight types of water samples were obtained from the Paraho above-ground oil shale retort. These samples include three from different sampling sites on the retort, two from different sites in the oil storage facilities, and three samples from different sites at the evaporation pond. Analyses of the pH, oxidizing capacity as Eh, conductivity, alkalinity, ammonia, total sulfur, and thiosulfate are described. Also, the results of these analyses are presented for water samples prepared and stored by different methods. Special methods were developed for the conductivity analysis. The results for the total sulfur analysis are doubtful; a number of problems are still to be solved for this analysis. The water parameters that appear to be most vulnerable to handling and storage are the pH and conductivity. (See also W87-06871) (Author's abstract)
W87-06882

DETERMINATION OF AROMATIC HYDROCARBONS IN BIOLOGICALLY TREATED WATER FROM A COAL GASIFICATION PROCESS,
Waters Associates, Milford, MA.
W. A. Dark.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 142-148, 5 fig, 11 ref.

Descriptors: *Analytical methods, *Sample preparation, *Chromatography, *Hydrocarbons, *Aromatic compounds, *Industrial wastewater, Water quality control, Coal, Gasification, Monitoring, Biological treatment, Sludge, Activated sludge, Detection limits, Effluents.

A high performance liquid chromatography gradient scheme was used to separate the aromatic hydrocarbons in the aqueous effluents of a coal gasification process. Samples of raw water, activated sludge, and activated sludge plus carbon-treated effluents were evaluated. By using a simple chromatographic concentration step before separation, the detection of aromatics below the parts-per-million level can be done routinely. Employing multiple detectors aids in peak identification. The use of activated sludge plus activated charcoal was highly effective in removing aromatic hydrocarbons from the aqueous effluent of this gasifier. The final treated effluent contained some hydroxy-substituted multiring aromatics that were not removed by these treatments. (See also W87-06871) (Author's abstract)
W87-06883

DETERMINATION OF POLYNUCLEAR AROMATIC HYDROCARBONS IN WASTEWATER FROM COAL LIQUEFACTION PROCESSES BY THE GAS CHROMATOGRAPHY-ULTRAVIOLET SPECTROMETRY TECHNIQUE,
Exxon Research and Engineering Co., Linden, NJ.
W. K. Robbins, T. D. Searl, D. H. Wasserstrom, and G. T. Boyer.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 149-166, 4 fig, 8 tab, 15 ref.

Descriptors: *Analytical methods, *Process waters, *Hydrocarbons, *Polynuclear aromatic compounds, *Gas chromatography, *Industrial wastewater, Coal, Liquefaction, Water quality control, Ultraviolet spectrometry, Phenanthrene, Benzanthracene, Benzopyrene, Methylene chloride, Isotope studies, Sample preparation, Spectral analysis.

One of the classes of compounds that may be present in wastewater from coal conversion plants is polynuclear aromatic hydrocarbons (PAH). Since 13 PAHs containing from three to six condensed rings are on the U.S. Environmental Protection Agency (EPA) list of priority pollutants, an analytical method was developed for the determination of PAHs in process waters from coal liquefaction processes. This method utilizes the well-established gas chromatography-ultraviolet spectrometry (GC-UV) technique to determine the 13 PAHs at the 0.1 ppb (micrograms/L) level and higher. Isomers and twelve additional PAHs are routinely measured, and the technique may be extended as necessary to cover other compounds as well. In the method, each wastewater sample is spiked with (14-C)phenanthrene, (14-C)benz(a)anthracene, and (14-C)benzo(a)pyrene prior to extraction with methylene chloride. The methylene chloride phase is then washed with aqueous acid and base to remove phenols, organic acids, and basic nitrogen compounds. The methylene chloride neutrals are then solvent exchanged into cyclohexane, and the cyclohexane phase is extracted with N-methylpyrrolidone (NMP). A PAH-rich fraction suitable for GC-UV measurement is obtained by dilution of the NMP with water and back extraction into isooctane. In the GC-UV measurement step, the PAHs are separated by gas chromatography and the component fractions trapped. After dissolution of the PAHs from the traps, ultraviolet absorption measurements are made for the individual PAHs. Peaks containing the carbon-14 internal standards are assayed for radioactivity, and the ratio of the final to the initial radioactivity is used to quantitate the data. With this technique, the effect of the coal type and the reaction conditions can be determined. PAH analyses of several raw wastewaters obtained from coal liquefaction pilot plants are presented and discussed. (See also W87-06871) (Author's abstract)
W87-06884

MULTICOMPONENT METHODS FOR THE IDENTIFICATION AND QUANTIFICATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE AQUEOUS ENVIRONMENT,
Oak Ridge National Lab., TN. Analytical Chemistry Div.
W. H. Griest, M. P. Maskarinec, S. E. Herbes, and G. R. Southworth.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 167-178, 2 fig, 3 tab, 26 ref. DOE Contract W-7405-eng-26.

Descriptors: *Analytical methods, *Pollutant identification, *Water analysis, *Aromatic compounds, *Hydrocarbons, Aquatic environment, Chemical analysis, Industrial wastewater, Process water.

The development of a sensitive and specific analytical methodology for the determination of the polycyclic aromatic hydrocarbon (PAH) content of aqueous samples is critical to studies defining the discharge, distribution, persistence, and fate of PAHs in the aqueous environment. Multicomponent PAH analysis methods developed in this laboratory for freshwater streams and rivers and the application of these methods to samples from the aqueous environment around a coal coking plant are discussed. (See also W87-06871) (Author's abstract)
W87-06885

COMPARISON OF ANALYTICAL METHODS FOR PHENOLS, CYANIDE, AND SULFATE AS APPLIED TO GROUNDWATER SAMPLES FROM UNDERGROUND COAL GASIFICATION SITES,
Lawrence Livermore National Lab., CA.
F. T. Wang.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 179-184, 1 fig, 2 tab, 9 ref.

Descriptors: *Comparison studies, *Phenols, *Cyanide, *Sulfates, *Pollutant identification, *Groundwater pollution, *Sample preservation, Sample preparation, Water quality control, Chemical analysis, Field tests, Analytical methods.

Groundwater samples, obtained near two underground coal gasification experiment sites, were analyzed for phenols, cyanide, and sulfate. The samples were analyzed in the field; they were also preserved and sent to remote laboratories for analysis. Comparisons of the results have shown that the agreement between laboratory and field analyses is fairly good. This indicates that the methods of preservation are effective for these types of groundwater samples and that field analysis gives reliable information. (See also W87-06871) (Author's abstract)
W87-06886

ANALYSIS OF LEACHATES FROM SELECTED FOSSIL ENERGY WASTES FOR CERTAIN EPA CRITERIA POLLUTANTS,
Engineering-Science, Fairfax, VA.
W. P. Gulledge, and W. C. Webster.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 185-194, 6 tab, 8 ref.

Descriptors: *Comparison studies, *Analytical methods, *Leachates, *Solid wastes, *Pollutant identification, Industrial wastewater, Fuel, Extraction, Sample preparation, Heavy metals.

Leach test results from three extraction procedures are presented and discussed as they relate to the possible regulation of fossil energy wastes under the Resource Conservation and Recovery Act. Under the Phase II testing program conducted by ASTM Committee D-19 on Water, through its Subcommittee D19.12 on Pollution Potential of the Leaching from Solid Wastes, data were obtained on the leachate characteristics of 19 fossil energy wastes. The data show a wide variation in values obtained by several different laboratories for a given waste and extraction procedure. Using a level of ten times the U.S. Environmental Protection Agency's Proposed Interim Primary Drinking Water Standards as a basis for determining hazard potential, the levels of heavy metal ions leached from the fossil fuel wastes tested occasionally exceeded the point of violation for all three extraction procedures. (See also W87-06871) (Author's abstract)
W87-06887

MOBILE WELLHEAD ANALYZER FOR THE DETERMINATION OF UNSTABLE CONSTITUENTS IN OIL-FIELD WATERS,
Fort Detrick, Frederick, MD.
For primary bibliographic entry see Field 7B.
W87-06892

OFFSHORE FILTRATION TESTING AND ANALYSIS OF SEAWATER FOR OIL-FIELD INJECTION,
Serck Water Processing, Gloucester (England).
J. B. Cappi, and H. R. Blagden.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 49-67, 9 fig, 2 tab.

Descriptors: *Offshore platforms, *Seawater, *Oil fields, *Injection water, *Industrial water, *Filtration, Water quality, Suspended solids, *Water analysis, Particle size, Process water.

A high rate media-type filter developed for water injection applications was tested on a 4000 BWPD (barrels of water per day) pilot plant to gather data on water quality achievable on equipment practical for offshore oil production installations. The work was spread over 13 offshore locations around the world in seven different seas that represent a wide variety of water types, levels of suspended solids, temperatures, and depths. The test procedures and analytical techniques used on these trials are described together with the filtering characteristics of various seawaters. Analysis included Coulter Counting, core testing, millipore tests, gravimetric, turbidity, and residual chlorine. (See also W87-06888) (Author's abstract)
W87-06893

VARIOUS METHODS USED IN EVALUATING THE QUALITY OF OIL-FIELD WATERS FOR SUBSURFACE INJECTION,
N.L. Treating Chemicals Lab., Houston, TX.
L. N. Strickland.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 68-88, 1 fig, 8 tab, 14 ref.

Descriptors: *Water quality, *Industrial water, *Oil fields, *Injection water, *Water analysis, Corrosion, Bacteria, Oxygen, Suspended solids, Filtration.

A variety of tests are required in order to determine the quality of water in subsurface injection operations. Water analyses, scaling tendancies, compatibility of mixed waters, residual hydrocarbon content, oxygen content, presence of bacteria, corrosion resulting from the water(s), and the type and quantity of suspended solids must be determined in order to evaluate the water quality for subsurface injection. Most of the tests must be conducted in the field with some additional tests conducted in the laboratory. A well-designed and conscientiously-operated handling system that provides high quality water can pay for itself in waterflooded operations by keeping 'down time' to a minimum and the water injection volume at a maximum. With the maximum volume of water injected, more oil will be recovered in a shorter period of time, making a waterflood more profitable. High quality water injected into disposal wells assures minimal operational problems and reduced cost of operation due to fewer workovers or less frequent back-washing, or acidizing of the disposal wells. (See also W87-06888) (Lantz-PTT)
W87-06894

MONITORING ACROLEIN IN NATURALLY OCCURRING SYSTEMS,
Magna Corp., Santa Fe Springs, CA.
C. L. Kissel, J. L. Brady, A. M. Guerra, M. J. Meshishnek, and B. A. Rockie.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 102-116, 5 fig, 6 tab, 22 ref.

Descriptors: *Monitoring, *Biocides, *Water analysis, *Acrolein, Sulfides, Chemical analysis, Water quality, Polarography, Spectroscopy, Pollutant identification.

Acrolein is an important biocide and sulfide scavenger for oil field systems. Acrolein monitoring procedures usually involve both concentration and performance determinations. These procedures can provide useful information only when meaningful methods are employed. Acrolein concentrations may be determined analytically by derivatization methods such as m-aminophenol fluorescence and dinitrophenylhydrazine colorimetry. Derivatization methods can be used only in special situations because numerous interferences are usually present. Direct analytical methods such as ultraviolet spectroscopy and differential pulse polarography are generally more useful. An analytical method should be used only after careful studies have shown it to be reliable, suitable, and parallel to the desired performance in the given application. In most cases, monitoring acrolein is best done by determining its performance in each specific application. When used as a biocide, acrolein is more accurately evaluated by standard American Petroleum Institute (API) procedures than by present adenosinetriphosphate (ATP) methods. Growth in aerobic plates and anaerobic culture tubes is normally absent at typical use concentrations even though ATP readings generally register low kills. Acrolein appears to alter the mechanism of light emission by ATP. When used to scavenge sulfides, acrolein performance is best evaluated by a sulfide specific ion electrode, because results can be misleading when determined by lead or methylene blue colorimetry. This conclusion was obtained when colorimetric methods were compared with the data from sulfide specific ion electrode determinations calibrated against lead perchlorate titrations. (Seealso W87-06888) (Author's abstract)
W87-06896

VALIDATION AND PREDICTABILITY OF LABORATORY METHODS FOR ASSESSING THE FATE AND EFFECTS OF CONTAMINANTS IN AQUATIC ECOSYSTEMS.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5C.
W87-06912

EXPERIMENTAL PONDS FOR EVALUATING BIOASSAY PREDICTIONS,
Kansas Univ., Lawrence. Experimental and Applied Ecology Program.
For primary bibliographic entry see Field 5C.
W87-06919

COMPARISON OF LABORATORY AND FIELD ASSESSMENT OF FLUORENE - PART I: EFFECTS OF FLUORENE ON THE SURVIVAL, GROWTH, REPRODUCTION, AND BEHAVIOR OF AQUATIC ORGANISMS IN LABORATORY TESTS,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W87-06921

COMPARISON OF LABORATORY AND FIELD ASSESSMENT OF FLUORENE - PART II: EFFECTS ON THE ECOLOGICAL STRUCTURE AND FUNCTION OF EXPERIMENTAL POND ECOSYSTEMS,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W87-06922

MANUAL OF ANALYTICAL METHODS FOR WASTEWATERS (OIL SHALE RETORT WATERS).
California Univ., Berkeley. Lawrence Berkeley Lab.
Available from the National Technical Information Service, Springfield, Virginia. 22161, as DE84015967. Price codes: A12 in paper copy, A01 in microfiche. Lawrence Berkeley Laboratory Report LBL-17421, May 1984. 249 p. Edited by Christian Gaaei Daughton. DOE Contract DE-AC03-76SF00098.

Descriptors: *Water analysis, *Analytical methods, *Wastewater, *Oil shale, *Wastewater analysis, Industrial wastewater, Chemical analysis, Nitrogen, Carbon, Ammonia, Biomass, Chemical oxygen demand, Fractionation.

This manual of methods was developed for the routine chemical analysis of various water quality criteria. Each method is specifically adapted for application to the highly complex sample matrices of aqueous wastes that are generated by the pyrolytic production of shale oil. These methods have evolved from specific needs of the LBL-SEEHRL Oil Shale Project for the study waste treatment. Although the methods have been developed specifically for oil shale wastewaters, the stringent requirements imposed by these sample matrices would probably allow for the successful direct application of these methods to other aqueous waste samples; the major limitation would be that of insufficient lower detection limits, because oil shale wastewaters commonly require methods with wide linear dynamic ranges. Discussions of theory, literature review, methods comparisons, validation and precision data, and detailed operator protocols are presented for each of the methods, including: quantitation of organic and inorganic carbon, ammonia, organic nitrogen, total nitrogen, chemical oxygen demand, and microbial biomass. Methods are also presented for simple and rapid fractionation of organic carbon (also used for quantifying oil and grease) and for separating ammonia from organic nitrogen (for organic nitrogen analysis). Some of the protocols are routine standard methodologies that have been validated for oil shale process wastewaters, while others are modified standard methods or totally new approaches. The question of accuracy has not been fully addressed in these chapters because it is a tremendously complex issue. (See also W87-06930 thru W87-06936) (Lantz-PTT)
W87-06929

RAPID FRACTIONATION OF OIL SHALE WASTEWATERS BY REVERSE-PHASE PARTITIONING,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. G. Daughton, B. M. Jones, and R. H. Sakaji.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 1-25, 3 fig, 4 tab, 27 ref.

Descriptors: *Analytical methods, *Water analysis, *Pollutant identification, *Oil shale, *Chemical analysis, *Wastewater analysis, *Chromatography, Organic compounds, Organic carbon, Chemical oxygen demand, Hydrocarbons, Spectral analysis.

A simple and rapid method is described for quantifying polar and nonpolar organic solutes as bulk, colligative properties of complex oil shale process wastewaters. These two classes are separated by reverse-phase chromatographic partitioning, using a stationary phase of octadecylsilyl-bonded silica. Unretained organic solutes in the fractionated, aqueous effluent are classified as belonging to the hydrophilic fraction (HpF); these solutes contain polar functional groups. Those that are retained belong to the lipophilic fraction (LpF); these solutes contain few polar functionalities and are elutable with organic solvents. Nonspecific, coligative measurements such as total organic carbon or chemical oxygen demand can be used to quantitate the organic solutes directly (in the HpF) or indirectly, by difference (in the LpF). For nine wastewaters from oil shale retorting processes, the proportion of organic carbon in the HpF ranged from less than 20% to more than 80%. This reverse-phase fractionation (RPF) method also can be applied to the quantitation of 'oil and grease' and aliphatic (true) oil in aqueous wastes. The compounds in the retained LpF can be eluted with Freon 113, and the infrared (IR) absorbance of the asymmetric methylene C-H stretch at 2930/cm can be determined and compared with that of oil standards as a measure of 'oil and grease'; if the Freon eluent is passed over normal-phase silica, the 'greases' are removed, and the true oil in the effluent can be quantified. Values for oil and grease (dissolved) ranged from 56 to 448 mg/L for seven waters when quantified as mineral oil by IR. (See W87-06929) (Author's abstract)
W87-06930

SEPARATION OF AMMONIA FROM ORGANIC NITROGEN USING TUBULAR MICROPOROUS POLYTETRAFLUOROETHENE MEMBRANES: NONOSMOTIC DISSOLVED-GAS DIALYSIS,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. G. Daughton, and R. H. Sakaji.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 26-51, 7 fig, 1 tab, 20 ref.

Descriptors: *Water analysis, *Analytical methods, *Sample preparation, *Ammonia, *Organic nitrogen, *Membrane processes, *Dialysis, *Pollutant identification, *Wastewater analysis, Organic compounds, Hydrogen ion concentration, Polytetrafluoroethene, Sulfuric acid, Osmosis.

A simple and rapid method is described for physically separating dissolved ammonia from organic nitrogen in complex wastewater samples, in particular oil shale process waters. This separation method has utility in directly quantifying organic nitrogen by nonspecific methods that ordinarily can only detect total nitrogen. The sample is buffered with a sodium carbonate solution to a pH of 10.5. This deprotonates the ammonium ion to dissolved ammonia gas, while many nitrogen heterocycles and aromatic and aliphatic amines remain nonvolatile because they either have vapor pressures lower than ammonia, high solubilities in the aqueous phases or remain protonated. The sample is introduced into a tubular microporous polytetrafluoroethene (Teflon) membrane. The ends of the tubing are sealed, and the membrane is immersed in a 1N sulfuric acid bath. The tubular membrane is extremely permeable to gases, but since it is hydrophobic, liquid water and associated nonvolatile solutes cannot permeate. The diffusion of ammonia is driven by the concentration gradient that is maintained across the membrane by absorbing the permeated ammonia into the acid solution, where it is protonated to give ammonium ion. The method is analogous to dialysis, but differs in that osmosis of liquid water does not occur; it is referred to as nonosmotic dissolved-gas dialysis. The dialyzed sample can then be analyzed for total nitrogen by a nonselective, rapid method such as combustion/chemiluminescence. The result is a direct and rapid estimate of organic nitrogen if the sample contains sufficiently low concentrations of nonvolatile inorganic nitrogen. (See also W87-06929) (Author's abstract)
W87-06931

CARBON ANALYSIS: UV-PEROXYDISULFATE OR HIGH-TEMPERATURE OXIDATION COUPLED WITH COULOMETRIC TITRATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
G. W. Langlois, B. M. Jones, R. H. Sakaji, and C. G. Daughton.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 52-105, 7 fig, 4 tab, 48 ref, 2 append.

Descriptors: *Water analysis, *Analytical methods, *Carbon, *Chemical analysis, *Coulometry, *Titration, *Wastewater analysis, Ultraviolet radiation, Photochemistry, Organic carbon, Nitrogen, Dissolved carbon, Oil shale.

Wastewaters from the production of synfuels, in particular oil shale retort waters, present several major problems to various instrument configurations designed for carbon analysis. A carbon analyzer was fabricated from commercially available oxidation and detection units. Carbon oxidation occurred in an ultraviolet (UV) photochemical reactor using acid peroxydisulfate as a source of oxidant; quantitation of the evolved carbon dioxide was accomplished with an automatic coulometric titrator. This new design eliminated the problems of (i) instrument downtime caused by fouling of high-temperature combustion catalysts and corrosion of furnace combustion tubes, (ii) limited linear dynamic range and upper detection limit (viz., infrared detection), and (iii) frequent detector calibration (viz., infrared and flame ionization detection). The UV-persulfate/coulometric titration carbon analyzer was compared statistically with a high-temperature combustion system that is suitable for use with an ASTM method of carbon analysis. The basis of the comparison was: (i) the accuracy and precision of recovery of total dissolved carbon (TDC) and dissolved organic carbon (DOC) for individual nitrogen heterocycles, which were of primary interest because of their preponderance in oil shale process waters and their reported resistance to certain oxidation method, and (ii) the precision of TDC and DOC determinations for nine oil shale process wastewaters. Several quantitative considerations are discussed for both analyzers, including ease of operation, instrument downtime, and maintenance costs. (See also W87-06929) (Author's abstract)
W87-06932

AMMONIA: COLORIMETRIC AND TITRIMETRIC QUANTITATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. G. Daughton, J. Cantor, B. M. Jones, and R. H. Sakaji.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 106-130, 3 tab, 18 ref, append.

Descriptors: *Analytical methods, *Pollutant identification, *Ammonia, *Colorimetry, *Titration, *Quantitative analysis, *Wastewater analysis, Ions, Electrodes, Measuring instruments, Chromatography, Chemical analysis, Oil shale.

In this report, ammonia is used as a colligative term for both of the ammoniac species, ammonia and ammonium ion. Only three approaches are available to a routine wet-chemistry laboratory for quantitating these species as total ammonia: (1) colorimetry, (2) titrimetry, and (3) direct ammonia-selective electrode; other, less routine methods, include ion chromatography, gas-liquid chromatography, combustion/chemiluminescence, diffusion/UV absorbance, and highly specific enzymatic assays; three of these methods (ammonia electrode, ion chromatography, and gas diffusion) never evaluated for retort waters. Methods that employ the routine approaches are numerous, and most of them give excellent results for particular sample matrices. These three routine methods were extensively evaluated for oil shale wastewaters. Methods for colorimetry and acidimetric titrimetry proved comparable for 'accuracy'. Although both methods were very reproducible, the titrimetric method, when automated, was superior for precision. Gas-sensing electrodes from two manufacturers proved to be extremely unreliable even though they could possibly provide the fastest and easiest means of quantitation. Ammonia-sensing electrodes generate unstable response curves in oil shale retort waters, probably because their membranes become easily fouled and because surfactants (e.g., fatty acids) increase the membrane permeability to other interfering solutes. One electrode gave extremely stable readings in standard solutions, exhibited severe drift when immersed in oil shale wastewater samples, and subsequently failed to produce stable readings when reimmersed in standard solutions. Changes in the slope of the response curve made frequent recalibration prohibitively time consuming. (See also W87-06929) (Lantz-PTT)
W87-06933

NITROGEN: KJELDAHL AND COMBUSTION/CHEMILUMINESCENCE,
California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, G. J. Harris, and C. G. Daughton.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 131-199, 6 fig, 7 tab, 60 ref, 5 append.

Descriptors: *Analytical methods, *Nitrogen, *Wastewater analysis, *Kjeldahl procedure, *Chemiluminescence, *Combustion, Oil shale, Organic compounds, Pollutant identification, Fractionation, Dialysis, Chemical analysis.

Wastewaters from the recovery of shale oil are highly contaminated; organic nitrogen compounds (i.e., nitrogenous heterocycles and aromatic amines) have been postulated as responsible for a large portion of the biorefractory solutes. Total Kjeldahl nitrogen and organic Kjeldahl nitrogen, the standard methods for quantifying nitrogen in agricultural and biological wastewaters, are extremely time-consuming procedures, and nitrogenous heterocycles are notoriously resistant to the Kjeldahl digestion step. Total nitrogen (TN) as determined by combustion at 1100 C followed by excitation of the by-products with ozone to an electronically excited species (NO_2) and chemiluminescent detection, was demonstrated to recover a wide range of nitrogenous heterocycles. There was no statistically significant difference between TKN and TN for nine oil shale wastewaters. Two novel techniques (reverse-phase fractionation and nonosmotic dialysis) for the separation of ammonia from the sample matrix were evaluated for their ability to broaden the scope of C/CL analysis. Total nitrogen values for either the RPF nonpolar fraction or the dialyzed portion of oil shale wastewaters revealed that these methods of solute separation followed by analysis with C/CL may be the most rapid methods available for directly estimating organic nitrogen. These methods yield nitrogen values comparable with those for organic Kjeldahl nitrogen. (See also W87-06929) (Lantz-PTT)
W87-06934

CHEMICAL OXYGEN DEMAND (COD): COLORIMETRIC AND TITRIMETRIC QUANTITATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, R. H. Sakaji, and C. G. Daughton.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 200-233, 3 fig, 7 tab, 19 ref.

Descriptors: *Water analysis, *Analytical methods, *Wastewater analysis, *Chemical oxygen demand, *Colorimetry, *Titration, Oil shale, Industrial wastewater, Analysis of variance, Mathematical analysis, Organic compounds, Comparison studies.

Two methods (macro-titrimetric and micro-colorimetric) are compared for the determination of COD in oil shale process waters. The results from nine oil shale wastewaters and from a composite

sample (comprising equal volumes of each water) showed that both methods are very precise. The precision of the macro-titrimetric method, however, was superior to the micro-colorimetric method. The results from a two-way analysis of variance (anova) on log-transformed data showed that there was no significant difference between COD methods. The anova data also indicated that there was no significant interaction between methods and waters. Although it has been hypothesized in the literature that sealed-tube digestion methods have improved COD recovery because of the capture of volatile compounds that would be lost during refluxing, the statistical analysis of the comparison study data did not reflect any difference between the two methods for oil shale process waters. The accuracy of the two COD procedures was assessed for high (192.7 mg/L) and low (10.4 mg/L) EPA quality control standards. For the titrimetric method, the recoveries were within 4% of the theoretical COD and within 1% of the empirical value reported by EPA. The relative standard deviations (rsd values) for five replicates were 2.4% and 5.7% for the high and low samples, respectively. For the colorimetric method, the recoveries were within 5% of the theoretical COD and within 1% of the empirical value reported by EPA (rsd = 13.9%) for the high range standard. The colorimetric procedure was inaccurate and imprecise for the low range standard. The accuracy of COD values is impossible to validate for a complex matrix such as oil shale process water; each wastewater is an unknown mixture of hundreds of organic compounds each of which maybe oxidized by a COD method to various degrees. The incomplete recovery of a spike of an easily mineralized organic compound, such as potassium hydrogen phthalate, from a waste gives an indication of matrix effects. (See also W87-06929) (Lantz-PTT)
W87-06935

MICROBIAL BIOMASS: QUANTITATION AS PROTEIN,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. G. Daughton, B. M. Jones, and R. H. Sakaji.
IN: A Manual of Analytical Methods for Wastewaters (Oil Shale Retort Waters), Lawrence Berkeley Laboratory Report LBL-17421, May 1984. p 234-247, 6 fig, 15 ref.

Descriptors: *Water analysis, *Analytical methods, *Wastewater analysis, *Biomass, *Microbiological studies, *Proteins, Turbidity, Dry cell mass, Oil shale, Industrial wastewater, Bacteria, Mathematical studies, Sample preparation.

The quantitation of microbial growth is necessary for the accurate assessment of biological waste treatment performance and is essential for execution of valid biodegradation experiments. The increase in biomass at stationary phases is an indirect measure of organic solute degradation; biomass determinations therefore can be used to validate the actual solute removal values that are determined by other means. Values for solute removal and biomass production can then be used to calculate growth yields. Oil shale process wastewaters have several characteristics that preclude the facile measurement of microbial biomass by the more often used methods such as dry cell mass, turbidity, or protein. Dry cell mass is usually measured after collection of cells on membrane- or glass-fiber filters or after centrifugation and separation of the cells from the supernatant fluid. Turbidity, a measure of the light-scattering properties of a mixture, is commonly used as a measure of suspended solids. Cellular material is easily quantitated by measurement of turbidity when the suspended cells are dispersed, but not when they are flocculent. The regressions of protein vs. relative bacterial concentration, dry mass, VSS, turbidity as absorbance, and nephelometric turbidity, had r-squared values of 0.996, 0.976, 0.978, 0.995, and 0.984. An excellent correlation of protein with relative bacterial concentration demonstrated that protein accurately reflected biomass concentration. Since protein concentration was shown to be linearly correlated with bacterial concentration, deviations from linearity for the other regressions must have resulted from nonlinearity of the alternate method. These deviations probably resulted from volatile abiotic particulates, inadequacies of gravimetric analysis, and secondary light scattering. Turbidity as absorbance yielded excellent results, but its use as a routine tool is limited because each sample must be zeroed against its own filtrate necessitating excessive sample consumption and preparation. (See also W87-06929) (Lantz-PTT)
W87-06936

LEACHING EXPERIMENTS ON COAL PREPARATION WASTES: COMPARISONS OF THE EPA EXTRACTION PROCEDURE WITH OTHER METHODS,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5E.
W87-06945

DEVELOPMENT OF A MODIFIED ELUTRIATE TEST FOR ESTIMATING THE QUALITY OF EFFLUENT FROM CONFINED DREDGED MATERIAL DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. R. Palermo.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report D-86-4, August 1986. Final Report. 50 p, 30 fig, 20 tab, 104 ref, append.

Descriptors: *Analytical methods, *Effluents, *Waste disposal, *Disposal sites, *Dredging, Chemical analysis, Elutriate, Water quality control, Path of pollutants, Water quality, Simulation analysis, Prediction.

The quality of effluent discharged from confined dredged material disposal areas is an environmental concern when the sediments to be dredged are contaminated. This report describes the development of a modified elutriate test procedure for prediction of the quality of effluent from confined dredged material disposal areas. The test was developed to simulate the physicochemical conditions in confined disposal areas which would effect the release of contaminants. The test development included experiments comparing suspended solids and particle grain-size distributions for test vessel selection. Factorial experiments were then conducted to select appropriate test factors for simulating the oxidizing conditions and retention times present in confined disposal areas. Limited field evaluations of effluent water quality were compared with the laboratory data. The test was found to adequately predict the dissolved concentration of contaminants and the fractions of contaminants associated with the suspended solids in the effluent. (Author's abstract)
W87-07028

EVALUATION OF A TEFLON HELIX LIQUID-LIQUID EXTRACTOR FOR CONCENTRATION OF TRACE ORGANICS FROM WATER INTO METHYLENE CHLORIDE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
R. J. Baker, J. Gibs, A. K. Meng, and I. H. Suffet.
Water Research WATRAG, Vol. 21, No. 2, p 179-190, February 1987. 5 fig, 9 tab, 16 ref. EPA Grant CR810484-01-0.

Descriptors: *Liquid-liquid extraction, *Measuring instruments, *Sample preparation, *Analytical methods, *Methylene chloride, *Organic compounds, Performance evaluation, Solutions, Teflon, Extraction.

A continuous liquid-liquid extraction system (CLLE) for concentrating trace organics from water into methylene chloride for analysis was designed, built and evaluated. The CLLE uses Teflon coils for phase contact and gravity phase separation. The system includes a self-contained excess solvent distillation chamber, so the methylene chloride is recovered and recycled. A 90 l. Milli-Q water blank was run on the system. The CLLE extract was concentrated to 4 ml by Kuderna-Danish distillation, giving a 22,500:1 concentration ratio. Aqueous mixtures of organic compounds were used as test probes to evaluate the CLLE. Recovery values were determined for these compounds using CLLE and batch LLE (separatory funnel liquid-liquid extraction), and CLLE recoveries were found to be similar to those of batch LLE. Several statistical methods were applied to the data. For 9 of the 12 compounds that could be evaluated statistically, recoveries of 1 and 12.5 l. aqueous samples extracted by CLLE were found to be equivalent to 1 liter batch LLE recovery values. The units are portable, and are currently in service sampling raw and treated water at locations in the northeastern United States. (Author's abstract)
W87-07053

COEFFICIENT OF COMMUNITY LOSS TO ASSESS DETRIMENTAL CHANGE IN AQUATIC COMMUNITIES,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5E.
W87-07058

DETOXIFICATION OF CHLORINE DIOXIDE (CLO2) BY ASCORBIC ACID IN AQUEOUS SOLUTIONS: ESR STUDIES,
National Inst. of Radiological Sciences, Chiba (Japan).
For primary bibliographic entry see Field 5F.
W87-07060

STUDIES IN THE RATIO TOTAL MERCURY/METHYLMERCURY IN THE AQUATIC FOOD CHAIN,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.).
K. May, M. Stoeppler, and K. Reisinger.
Toxicological and Environmental Chemistry TXECBP, Vol. 13, No. 3/4, p 153-159, January 1987. 1 fig, 1 tab, 10 ref.

Descriptors: *Path of pollutants, *Analytical methods, *Pollutant identification, *Mercury, *Methylmercury, *Detection limits, *Food chains, Algae, Mussels, Mercury compounds, Tissue analysis, Fish.

A rapid and extremely sensitive method for the separation of inorganic mercury (Hg) from methylmercury (MeHg) and the simultaneous determination of both compounds by CVAAS (cold vapor atomic absorption spectroscopy) was developed. The determination limit of the total procedure for MeHg is approximately 0.2 microgram(ug)/kg for solids, 0.1 ug/kg for biological fluids like blood and urine, and 0.2 ug/kg for aqueous samples. The determination of inorganic Hg and MeHg of some links of the aquatic food chain according to this method resulted in high percentages of inorganic Hg (84.7-85.&% of total Hg) and low percentages of MeHg (14.3-15.3% of total Hg) for algae. While already mussels show lower percentages of inorganic Hg (44.4-79.9% of total Hg) but higher percentages of MeHg (20.1-55.0% of total Hg), all fish samples yield by far the lowest percentages of inorganic Hg (1-26.0% of total Hg) and as expected the highest percentages of MeHg (73.1-99% of total Hg). The ratio MeHg/total Hg found in fish even in fish of different species is approximately constant. (Author's abstract)
W87-07071

ESTIMATION OF BACTERIAL NITRATE REDUCTION RATES AT IN SITU CONCENTRATIONS IN FRESHWATER SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
C. A. Hordijk, M. Snieder, J. J. M. van Engelen, and T. E. Cappenberg.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 2, p 217-223, February 1987. 4 fig, 2 tab, 28 ref.

Descriptors: *Analytical methods, *Nutrients, *Cycling nutrients, *Chromatography, *Nitrate reduction, *Sediments, Detection limits, Kinetics, Model studies, Reduction, Estimating, Diffusion.

A method was developed to follow bacterial nitrate reduction in freshwater sediments by using common high-performance liquid chromatographic equipment. The low detection limit (14pmol) of the method enabled us to study of concentration profiles and reaction kinetics under natural conditions. Significant nitrate concentrations (1 to 27 micromolar) were observed in the sediment of Lake Vechten during the nonstratified period; the concentration profiles showed a successive depletion of oxygen, nitrate, and sulfate with depth. The profiles were restricted to the upper 3 cm of the sediment which is rich in organics and loosely structured. Nitrate reduction in the sediment-water interface followed first-order reaction kinetics at in situ concentrations. Remarkably high potential nitrate-reducing activity was observed in the part of the sediment in which nitrate did not diffuse. This acitivity was also observed throughout the whole year. Estimates of K sub m varied between 17 and 100 micromolar and V sub max varied between 7.2 and 36 micromole/cu cm/d for samples taken at different depths. The diffusion coefficient of nitrate (.0000096 to .0000104 sq cm/s) across the sediment-water interface was estimated by a constant-source technique and applied to a mathematical model to estimate the net nitrate reduction during the nonstratified period. In this period, observed nitrate reduction rates by the model, 0.2 to 0.4 mmol/sq m/d, were lower than those found for oxygen (27 mmol/sq m/d) and sulfate (0.4 mmol/sq m/d). During the summer stratification, nitrate was absent in the sediment and reduction could not be estimated by the model. (Author's abstract)
W87-07075

DEVELOPMENT OF A TOTAL SUSPENDED SOLIDS STANDARD,
International Paper Co., Mobile, AL. Erling Riis Research Center.
D. M. Strizak.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 115, February 1987. 1 tab, 4 ref.

Descriptors: *Suspended solids, *Standards, *Wastewater quality standards, *Quantitative analysis, *Wastewater treatment, *Data acquisition, Microcrystalline cellulose, Wastewater analysis, Particle size, Precision.

No easily prepared standard existed for total suspended solids (TSS) testing which is necessary for wastewater quality analysis. Microcrystalline cellulose (MCC) with an average 20 micron particle size normally used in thin layer chromatography was tested and found to be an effective TSS standard. Its size is larger than the pore size of most glass fiber filters used for TSS testing, so recovery percentages are high and cellulose is chemically stable and not easily biodegradable over short periods of time. Results showed good precision and accuracy; all TSS tests were within 0.5 to 2.0 milligrams/L of their expected value, with a standard deviation of 0.17 to 1.94 milligrams/L. (Wood-PTT)
W87-07102

DEVICE FOR SAMPLING THE MUD-WATER INTERFACE IN EUTROPHIC LAKES AND BOGS FOR RESIDUE ANALYSIS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 7B.
W87-07138

INVESTIGATION OF THE MULTIELEMENT CAPABILITY OF LASER-ENHANCED IONIZATION SPECTROMETRY IN FLAMES FOR ANALYSIS OF TRACE ELEMENTS IN WATER SOLUTIONS,
Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Fysik.
For primary bibliographic entry see Field 2K.
W87-07140

USE OF COMMERCIAL ACRYLONITRILE STANDARD FOR WASTEWATER ANALYSIS,
Professional Analtyical and Consulting Services, Inc., Coraopolis, PA.
H. G. Nowicki, and B. Nowicki.
Analytical Letters ANALBP, Vol. 19, No. 21/22, p 2095-2101, November 1986. 1 tab, 3 ref.

Descriptors: *Organic compounds, *Standards, *Regulations, *Quantitative analysis, *Acrylonitrile, Sampling, Environmental protection, Wastewater treatment, Detection limits, Gas chromatography, Industrial wastes.

It was found that a commercially available aqueous standard solution of acrylonitrile (1 mg/ml) was below manufacturer specification (up to approximately 30%) when compared to an authentic standard prepared from the pure compound. Comparative analyses of the two solutions were conducted by gas chromatography using a flame ionization detector with analytical conditions similar to those recommended by the EPA for acrylonitrile analyses. Commercial vendors have provided solutions of the the 114 organic priority pollutants which are convenient for instrumental calibration. There needs to be concern for experimental results reported with regards to accuracy and estimated detection limit when using such standards. (Author's abstract)
W87-07147

FLUORESCENCE DETECTION OF SOME NITROSOAMINES IN HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AFTER POST-COLUMN REACTION,
Kyungpook National Univ., Taegu (Republic of Korea). Dept. of Chemistry.
S. H. Lee, and L. R. Field.
Journal of Chromatography JOCRAM, Vol. 386, p 137-148, January 1987. 8 fig, 2 tab, 16 ref.

Descriptors: *Pollutant identification, *Analytical methods, *Sample preparation, *Nitrosamines, *Fluorescence, Chromatography, *Carcinogens, *Trace levels, Detection limits, Nitrogen compounds, Food processing industry, Chemical reactions, Chemical analysis, Nitrites, Selectivity.

A selective fluorescence detection method for the determination of some N-nitrosamines after post-column reaction was developed for reversed phase liquid chromatography. The N-nitroso compounds are analyzed by allowing their hydrolysis products to react with the oxidizing species Ce(4+) to produce the fluorescent ion Ce(3+). The detection limit for this method is at the ppb (American billion, 10 to the 9th power) level with a linear dynamic range of 2-3 orders of magnitude. (Author's abstract)
W87-07163

HIGHLY SELECTIVE DETERMINATION OF TRACE AMOUNTS OF COPPER(II), NICKEL(II) AND VANADIUM(V) IONS WITH TETRADENTATE SCHIFF-BASE LIGANDS BY REVERSED PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AND SPECTROPHOTOMETRIC DETECTION,
Tohoku Univ., Sendai (Japan). Dept. of Applied Chemistry.
M. Kanbayashi, H. Hoshino, and T. Yotsuyanagi.
Journal of Chromatography JOCRAM, Vol. 386, p 191-197, January 1987. 6 fig, 16 ref.

Descriptors: *Pollutant identification, *Analytical methods, *Sample preparation, *Trace metals, *Chromatography, *Spectrophotometry, *Chelating agents, Copper, Nickel, Vanadium, Heavy metals, Selectivity.

The highly selective determination of trace amounts of metal ions by reversed-phase high-performance liquid chromatography (HPLC) and spectro-photometric detection was accomplished without the addition of a chromogenic reagent to the eluent. Six tetradentate Schiff-base ligands, all N,N'-o-phenylenebis(salicylaldimine) (PBS) derivatives, were synthesized and made to react with the metal ions. These reagents have a high selectivity towards Co(2+), Cu(2+), Ni(2+), and V(5+) ions among 11 metal ions (these plus Al(3+), Cr(3+), Fe(3+), Ga(3+), Mn(2+), Mo(6+), and Zn(2+)). By chromatographing the derivatized metals in the HPLC system, highly sensitive and selective spectrophotometric methods for trace amounts of Cu(2+), Ni(2+), and V(5+) were established. For example, 4,4'-di-N,N'-diethyl PBS was suitable for the determination of trace amounts of V(5+). In this system, the V(5+) ion can be selectively determined at the ppb level without any preliminary concentration and separation. The detection limit of the V(5+) ion was 6 x 10 to the minus 9th power mol/L (0.3 ppb) at a signal-to-noise ratio of 2. (Author's abstract)
W87-07164

ORGANOCHLORINE RESIDUES IN RIVER PO SEDIMENT: TESTING THE EQUILIBRIUM CONDITION WITH FISH,
Istituto di Ricerca sulle Acque, Milan (Italy).
S. Galassi, and M. Migliavacca.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 120-126, October 1986. 3 fig, 2 tab, 11 ref.

Descriptors: *Organochlorines, *Sediments, *River Po, *Path of pollutants, *Bioindicators, Organic matter, Bioaccumulation, Pesticides, Polychlorinated biphenyls.

Organochlorine residues were determined in sediment samples collected in the River Po, during 1980-1982 at five sampling stations. Significant higher levels were observed in a deposition area after the confluence of a very polluted tributary. No significant differences could be observed with respect to the sampling period. Residue concentrations in sediment were correlated with the organic matter content. By using soil partition coefficients and bioconcentration factors in fish, pesticide and PCB concentrations in fish were calculated from sediment values and compared with measured values from a previous investigation. Tentatively a quality criterion for PCB in sediment is proposed. (Author's abstract)
W87-07206

PICOMOLAR MERCURY MEASUREMENTS IN SEAWATER AND OTHER MATERIALS USING STANNOUS CHLORIDE REDUCTION AND TWO-STAGE GOLD AMALGAMATION WITH GAS PHASE DETECTION,
Connecticut Univ., Groton. Marine Sciences Inst.
G. A. Gill, and W. F. Fitzgerald.
Marine Chemistry MRCHBD, Vol. 20, No. 3, p 227-243, January 1987. 3 fig, 4 tab, 54 ref. NSF Grants OCE-77-13071, OCE-77-13072 and OCE-81-12104.

Descriptors: *Analytical methods, *Mercury, *Natural waters, *Sample preparation, *Detection limits, Stannous chloride, Reduction, Gold, Measuring instruments, Spectral analysis, Amalgamation.

Sampling and analytical methodologies were developed and tested which are non-contaminating, accurate, and sensitive, permitting the reliable determination of picomolar levels of Hg in natural waters. Mercury was isolated from solution using SnCl2 reduction and gas phase stripping with collection and concentration onto Au utilizing Class 100 clean laboratory conditions and practices. Mercury detection was conducted using a two-stage Au amalgamation gas train to introduce elemental Hg0 vapor into the gas cell of a flameless atomic absorption spectrophotometer. By carefully controlling and precisely estimating the procedural blank, a detection limit of 0.21 pM was achieved using a 2-1 sample volume for analysis. An analytical precision of about 10% was obtained for solutions with Hg contents between 2 and 20 pM using 500-ml aliquots for sample analysis. Verification of the analytical accuracy and precision of the method was demonstrated using aqueous laboratory and NBS standard reference materials spiked into acidified natural water samples at picomolar levels. Sample exposure to laboratory air containing elevated Hg was identified as a potentially serious source of Hg contamination to acidified natural water collections containing picomolar levels of Hg. Additional studies revealed that the bulk of Hg in open ocean and coastal seawater (>

88%) consists of labile species which are immediately reactive to SnCl2 reduction under acidic conditions. (Author's abstract)
W87-07221

APPRAISAL OF TESTS TO PREDICT THE ENVIRONMENTAL BEHAVIOUR OF CHEMICALS,
Scientific Committee on Problems of the Environment, Paris (France).
For primary bibliographic entry see Field 5B.
W87-07233

ROLE AND NATURE OF ENVIRONMENTAL TESTING METHODS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
K. Forte, W. Klein, and P. Sheehan.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 1-11, 22 ref.

Descriptors: *Path of pollutants, *Testing procedures, *Fate of pollutants, *Ecosystems, *Hazardous materials, *Prediction, Food chains, Bioaccumulation, Soil profiles, Toxicity, Aquatic environment, Atmosphere, Physicochemical properties, Water pollution sources, Degradation, Biodegradation.

Public demand for increased environmental protection has placed pressure on regulatory agencies and the scientific community to assess or predict the hazard of potentially toxic chemicals as quickly as possible. The focus of testing procedures must be specific to the environmental compartment in which the chemical occurs. Abiotic processes are virtually the only ones operating in the atmosphere. Assessment of abiotic fate should concentrate on photochemical decomposition under simulated atmospheric conditions. In aquatic ecosystems, both abiotic and biotic processes are important. The reactions and transport processes of chemicals in aquatic systems are highly dependent upon suspended particles, bottom sediments, living and dead organic materials, and natural variations in chemical composition of water and sediments, temperature, and biotic components. Terrestrial ecosystems are the most complex environmental compartment in which chemical compounds are deposited, transported, transformed and accumulated. The development of methodologies for examining chemical behavior in terrestrial systems has necessarily been pragmatic, and the need to examine the plant-soil system has been emphasized. Choice of test methods depends on the type of information desired. Two types of information are needed to predict the various aspects of chemical behavior: relative information allowing comparison of chemicals tested under similar conditions, and specific information identifying processes and metabolites, quantifying their exchange rates and estimating concentrations in environmental compartments under natural conditions. Tests for relative data include determination of physicochemical properties and the simpler qualitative laboratory tests indicating transport, transformation, accumulation and persistence of chemicals. Specific quantitative information generally requires more complex laboratory tests under simulated environmental conditions or direct assessment of chemical behavior under field conditions. (See also W87-07233) (Geiger-PTT)
W87-07234

REGULATORY NEEDS FOR TESTS TO PREDICT THE BEHAVIOUR OF ENVIRONMENTAL CHEMICALS.
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-07242

PROBLEMS IN ASSESSING ORGANICS CONTAMINATION IN GROUNDWATER,
Geraghty and Miller, Inc.
R. A. Saar.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 119-128, 2 tab, 10 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Organic compounds, Water quality control, Monitoring, Groundwater quality, Qualitative analysis, Quantitative analysis, Data interpretation.

Organic contamination of the groundwater near hazardous waste facilities and of municipal or industrial supply wells is widespread and undoubtedly has been for decades. However, a general awareness of this problem has come only in recent years. This awareness results from the widening availability of analytical instruments with low detection limits and from an increased understanding of the way contaminants move in the ground. During investigations of groundwater contamination, water samples are collected and analyzed by one or more laboratories. The results are frequently baffling. Organic compounds that are expected in water samples may be absent, and unexpected compounds may be present. Even if the expected compounds do appear, their relative concentrations may not reflect the quantities of chemicals used or dumped at a facility. An understanding of the principles that control the movement and interconversion of organic compounds in the ground and of how sampling and analysis may change a water sample usually help to explain many unexpected results. This chapter is divided into three parts: (1) deals with the qualitative aspects of organics in groundwater -- primarily with explanations for the occurrence of compounds that are not expected; (2) includes a quantitative discussion -- reasons why concentrations of various contaminants may be different from what is expected; and (3) includes recommendations that may make monitoring more reliable and facilitate the interpretation of groundwater quality data. (See also W87-07243) (Lantz-PTT)
W87-07254

PRIVATE WELL SAMPLING IN VICINITY OF RE-SOLVE, INC., HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
T. E. Tetreault, and P. M. Williams.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 129-140, 2 fig, 3 tab, 5 ref.

Descriptors: *Wells, *Groundwater quality, *Water quality control, *Hazardous wastes, *Massachusetts, Disposal sites, Public health, Methylene chloride, Organic compounds, Groundwater pollution, Trichloroethene, Pollutant identification.

Private well sampling, sampling protocol, collection procedures, presample purging, and sampling techniques are described as successful in that they provided verifiable and reproducible results when carefully followed. After a thorough review of existing analytical data, USEPA and Massachusetts DEQE have determined that the site does not present an immediate public health threat to the public water supply. Preliminary results of the private well sampling indicate that contaminated groundwater from the Re-Solve Inc. site has not polluted any of the actively used private wells in excess of established EPA Maximum Contaminant Levels at this time. Streams in the area of the Re-Solve site, i.e. Copicut River and Carol's Brook, have apparently acted as a hydraulic barrier to contaminant migration, and further field study is attempting to confirm this hypothesis. There were no contaminants detected in the private well water that pose a threat to public health. These findings confirmed the earlier testing completed by the DEQE in 1981. Since methylene chloride is frequently used in the extraction stage of analysis for organics, the presence of this compound may be due to laboratory contamination. The presence of bis (2-ethylhexyl) phthalate in sample PW100 indicates possible contaminant migration from the Re-Solve Site, however, this well is not presently used as a water supply by the residents of this household. Finally, the trace levels of 2-hexanone and 6.1 micrograms/L of trichloroethene in the sample from the D-7 water supply well do not exceed the established EPA Maximum Contaminant Levels (MCLs) for the given concentrations. Re-sampling of the six private wells will be performed again during the summer of 1983 by a WEPA contractor. (See also W87-07243) (Lantz-PTT)
W87-07255

POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY,
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 7B.
W87-07279

CRITICAL OVERVIEW OF POWER STATION SAMPLING AND ANALYSIS OF WATER AND STEAM,
Westinghouse Electric Corp., Philadelphia, PA.
For primary bibliographic entry see Field 7B.
W87-07281

CONSULTING ENGINEER'S ROLE IN POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 7B.
W87-07282

POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY,
Ontario Hydro Research Lab., Toronto.
For primary bibliographic entry see Field 7B.
W87-07283

POWER PLANT WATER QUALITY INSTRUMENTATION: A GUIDELINE FOR OPERATION, CALIBRATION, AND MAINTENANCE,
Selby and Associates, Chicago, IL.
For primary bibliographic entry see Field 7B.
W87-07285

PROGRAM FOR STEAM PURITY MONITORING: 1. INSTRUMENTATION AND SAMPLING,
Westinghouse Research and Development Center, Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07286

PROGRAM FOR STEAM PURITY MONITORING: 2. RESULTS OF POWER PLANT TESTING,
Westinghouse Research and Development Center, Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07287

QUANTIFICATION OF SODIUM, CHLORIDE, AND SULFATE TRANSPORT IN POWER-GENERATING SYSTEMS,
NWT Corp., San Jose, CA.
For primary bibliographic entry see Field 7B.
W87-07288

DETERMINATION OF ANIONS IN HIGH-PURITY WATER BY ION CHROMATOGRAPHY,
Calgon Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07289

RECENT ADVANCES IN ION CHROMATOGRAPHY,
American Univ., Washington, DC. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W87-07290

IN-PLANT SYSTEM FOR CONTINUOUS LOW-LEVEL ION MEASUREMENT IN STEAM-PRODUCING WATER,
General Electric Co., San Jose, CA. Advanced Reactor Systems Dept.
For primary bibliographic entry see Field 7B.
W87-07291

HIGH-PURITY WATER QUALITY MONITORING BASED ON ION-SELECTIVE ELECTRODE TECHNOLOGY,
Claremont Men's Coll., CA.
For primary bibliographic entry see Field 7B.
W87-07292

EVALUATION OF POWER PLANT MEASUREMENT OF SODIUM IONS IN HIGH-PURITY MAIN STEAM AND FEEDWATER UTILIZING IN-LINE CONTINUOUS SPECIFIC-ION ELECTRODES,
Baltimore Gas and Electric Co., MD.
For primary bibliographic entry see Field 7B.
W87-07293

USE OF ON-LINE ATOMIC ABSORPTION IN A POWER PLANT ENVIRONMENT,
Westinghouse Research and Development Center, Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07294

RESISTIVITY OF VERY PURE WATER AND ITS MAXIMUM VALUE,
Foxboro Analytical, Burlington, MA.
For primary bibliographic entry see Field 1A.
W87-07296

CONTINUOUS CONDUCTIVITY MONITORING OF ANIONS IN HIGH-PURITY WATER,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W87-07297

DESCRIPTION AND EVALUATION OF A CONTINUOUS SAMPLE WATER EVAPORATOR,
Babcock and Wilcox Co., Alliance, OH. Alliance Research Center.
For primary bibliographic entry see Field 7B.
W87-07298

DETERMINATION OF TRACE CHLORINE AND OXIDANTS IN SEAWATER BY DIFFERENTIAL PULSE POLAROGRAPHY,
EG and G Princeton Applied Research Corp., NJ.
G. Washinger, and P. Kark.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 213-226, 6 fig, 4 tab, 4 ref.

Descriptors: *Analytical methods, *Chlorine, *Oxidants, *Seawater, *Pulse polarography, *Pollutant identification, *Water quality, Phenylarsine oxide, Hydrogen ion concentration, Industrial water, Cooling water, Powerplants, Measuring instruments.

Described is a rapid and reliable technique for the determination of chlorine and other oxidants in power plant and industrial cooling waters, with particular emphasis on seawater systems. The analytical work is based upon the standard technique of chlorine and oxidant reduction by phenylarsine oxide. Excess phenylarsine oxide is detected quantitatively and nondestructively by differential pulse polarography and has a detection limit of less than 5 ppb chlorine equivalent. The procedures described in this paper are shown to be applicable for the analysis of total residual chlorine. However, extension of the principle to other types of oxidant determination under different conditions of pH and catalyst should be straightforward. (See also W87-07279) (Author's abstract)
W87-07299

WATER QUALITY MONITORING RIVERS AND STREAMS: 1984.
Indiana State Board of Health, Indianapolis. Div. of Water Pollution Control.
For primary bibliographic entry see Field 7C.
W87-07301

MARINE AND ESTUARINE GEOCHEMISTRY.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2L.
W87-07371

STABLE ISOTOPE AND AMINO ACID COMPOSITION OF ESTUARINE DISSOLVED COLLOIDAL MATERIAL,
Geological Survey, Reston, VA.
A. C. Sigleo, and S. A. Macko.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 29-46, 5 fig, 5 tab, 39 ref.

Descriptors: *Stable isotopes, *Amino acids, *Pollutant identification, *Estuaries, *Patuxent Estuary, *Maryland, Colloids, Seasonal variation, Surface water, Deep water, Carbon radioisotopes, Productivity.

Samples from the Patuxent Estuary, Maryland, were collected in surface water (0.5 m depth) and deep water (0.5 m above the sediment) pairs during a period of high productivity in July and a period of low productivity in October-November, 1983. Concentrations of total dissolved free amino acids (DFAA) were lower (0.06 to 1.9 microM) than those of dissolved combined amino acids (0.6 to 20 microM). Carbon isotope ratios in colloidal samples averaged -24.8/mil delta-13-C throughout the estuary for both seasons. In the colloidal material 15-N was enriched in the surface samples (10.8/mil average delta-15-N) relative to deep samples (8.5/mil average delta-15-N), whereas particulates (>0.4 micron) from the same stations were uniformly depleted in 15-N in surface waters relative to deep-water samples. All of the samples showed a strong seasonality, with higher values for 15-N in summer when the deep waters were anoxic. During periods of higher summer productivity, remineralized benthic ammonium as the primary source of nitrogen may be responsible for the 15-N enrichments observed in summer samples. (See also W87-07371) (Author's abstract)
W87-07373

THERMAL DEGRADATION PRODUCTS OF NON-VOLATILE ORGANIC MATTER AS INDICATORS OF ANTHROPOGENIC INPUTS TO ESTUARINE AND COASTAL SEDIMENTS,
Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 5B.
W87-07376

PARTITIONING OF PCBS IN MARINE SEDIMENTS,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-07377

AUTOMATED IRON MEASUREMENTS AFTER ACID-IRON WASTE DISPOSAL,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
M. F. Brown, D. R. Kester, and J. M. Dowd.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 157-169, 6 fig, 6 tab, 17 ref. NOAA Grant NA79AA-D-0003.

Descriptors: *Analytical methods, *Pollutant identification, *Path of pollutants, *Waste disposal, *Iron, *New Jersey, Acidity, Water analysis, Industrial wastes, Plumes, Monitoring, Ocean dumping.

An automated analytical procedure to measure iron in seawater based on a colorimetric method using the ferrozine reagent was developed. The method, applicable to iron concentrations in the range 0.02 to 10 micromoles/kg, was used to track an acid-iron waste plume that was formed after an acidic industrial waste highly concentrated in iron was dumped into the ocean at the Deepwater Dumpsite-106 (DWD-106) off the continental shelf of New Jersey. This automated system was used in conjunction with a submersible shipboard pumping system to obtain continuous real-time iron measurements in the waste plume. Real-time iron measurements were used to track an acid-iron waste plume for over 50-hr after a dump; a tenfold dilution of iron in the waste plume was observed during this period. Changes in the horizontal distribution of iron in two waste plumes discharged into the ocean within 2 km of each other were monitored for a period of 5 hr after the dump. The vertical dispersion of the waste in the ocean observed immediately after the dump and after the waste plume had mixed with seawater for over 50 hr suggests that the acid-iron waste does not penetrate the seasonal thermocline. (See also W87-07396) (Author's abstract)
W87-07404

MARINE AMOEBAE (PROTOZOA: SARCODINA) AS INDICATORS OF HEALTHY OR IMPACTED SEDIMENTS IN THE NEW YORK BIGHT APEX,
National Marine Fisheries Service, Oxford, MD. Northeast Fisheries Center.
For primary bibliographic entry see Field 5C.
W87-07413

ASTM POWER PLANT WATER ANALYSIS MANUAL.
American Society for Testing and Materials, Philadelphia, PA. Committee D-19 on Water.
Prepared by ASTM Subcommittee D19.11 on Water for Power Generation and Process Use. ASTM Publication code Number 03-419084-16 for bound copy and 03-419184-16 for loose-leaf copy. 1984. 212 p.

Descriptors: *Industrial water, *Water quality control, *Water analysis, *Manuals, Powerplants, Chemical analysis, Training, Standards, Sampling.

State-of-the-art methodology for the analyses of water samples is fundamental to a good water-chemistry maintenance program. Often both continuous analyzers and periodic laboratory analyses are necessary to maintain adequate water chemistry control. Currently, most power plants prepare a manual for routine usage by the chemical technician at the laboratory bench. Periodic training sessions are recommended. Evaluation of the applicability, accuracy, and precision of a method is the responsibility of the chemical supervisors. That information can generally be obtained by referring to the more detailed standard method or practice. The purpose of this manual is to provide a compilation of methods for use by the chemical technicians at electric power generating plants. Methods from Volumes 11.01 and 11.02 of the Annual Book of ASTM Standards, and other sources have been simplified so as to contain only that information essential to performing the analyses. Such a compilation, until now, has not been available to the industry. This edition does not contain all of the analytical chemistry methods that are used in a powerplant. Methods for the analyses of water that is to be discharged from the plant are specified by various regulating agencies and are not within the scope of this manual. Cleanliness is of the utmost importance to the technician, while obtaining and analyzing water samples. The sample can be easily contaminated by: (1) the surrounding atmosphere, (2) uncleaned sample bottles, (3) dirty laboratory ware, or (4) contact of the sample with the analyst's hands, clothing, etc. Touching the inside of the sample bottle or laboratory ware can contaminate the sample. In fact, virtually anything that contacts the sample during sampling or analysis is a potential source of contamination. Several methods are included in this manual for the same analysis. For example, four methods are included for

ammonia analyses; two methods, for boric acid; four methods, for chloride; etc. In those cases, a selection must be made according to: (1) expected concentration of the sample, (2) applicability of the method and possible interference from other chemicals that are in the sample, or (3) available analytical equipment and preference. (Lantz-PTT)
W87-07419

IDENTIFICATION OF EXISTING WATER QUALITY DATA.
JRB Associates, Inc., Bellevue, WA.
For primary bibliographic entry see Field 7B.
W87-07428

OCCURRENCE AND SPECIATION OF ORGANOMETALLIC COMPOUNDS IN FRESHWATER SYSTEMS,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W87-07468

BIOMASS DETERMINATIONS IN BIOPHYSICAL TREATMENT SYSTEMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-07502

EXTRACTION OF PERIPHYTON ADENOSINE TRIPHOSPHATE AND VARIABILITY IN PERIPHYTON-BIOMASS ESTIMATION,
Geological Survey, Salt Lake City, UT.
For primary bibliographic entry see Field 7B.
W87-07524

DETERIORATION OF MARBLE STRUCTURES: THE ROLE OF ACID RAIN,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 5C.
W87-07533

SIMULTANEOUS EXTRACTION OF TRIVALENT AND PENTAVALENT ANTIMONY AND ARSENIC SPECIES IN NATURAL WATERS FOR NEUTRON ACTIVATION ANALYSIS,
Idaho Univ., Moscow. Dept. of Chemistry.
W. M. Mok, and C. M. Wai.
Analytical Chemistry ANCHAM, Vol. 59, No. 2, p 233-236, January 1987. 1 fig, 4 tab, 22 ref.

Descriptors: *Analytical methods, *Sample preparation, *Pollutant identification, *Antimony, *Arsenic, *Neutron activation analysis, Data acquisition, Extraction, Hydrogen ion concentration, Chemical analysis, Water analysis, Speciation.

Antimony(III) and arsenic (III) in aqueous samples can be simultaneously extracted with ammonium pyrrolidinecarbodithioate (APCDT) into chloroform from pH 3 to 6. Extraction of antimony(V) and arsenic(V) can be achieved by reduction with thiosulfate and potassium iodide and pH 1 followed by APCDT extraction at the same pH value. The Sb- and As-complexes in the rganic phase can be back-extracted into a nitric acid solution for neutron activation analysis (NAA). Detection of 0.001 micrograms/L of antimony and arsenic can be achieved by using this extraction method and NAA. Applications of this method to antimony and arsenic speciation studies in natural water systems are discussed. (Author's abstract)
W87-07534

DIRECT DETERMINATION OF ARSENITE BY DIFFERENTIAL PULSE POLAROGRAPHY IN THE PRESENCE OF LEAD(II) AND THALLIUM(I),
Alaska Univ., Fairbanks. Dept. of Chemistry.
M. A. Reed, and R. J. Stolzberg.
Analytical Chemistry ANCHAM, Vol. 59, No. 3, p 393-395, February 1987. 3 fig, 3 tab, 11 ref. EPA Grant IAG DW14931442-01-0.

Descriptors: *Analytical methods, *Pollutant identification, *Arsenic compounds, *Chromatography, *Polarographic analysis, *Differential pulse polarography, Data acquisition, Chemical analysis, Ionic interference, Lead, Thallium, Heavy metals, Chemical reactions, Ion exchange, Resins, Copper, Pollutants.

Interference from Pb(II) and Tl(I) in the differential pulse determination of arsenite is eliminated by chromatography on a chelating ion exchange resin. Strong ligands prevent the removal of Pb, but addition of Cu(II) before chromatography results in successful analysis by dissociating the Pb complex. Since the interfering ions are removed from solution, greater than a 1000-fold mass excess of Pb and Tl can be tolerated. (Author's abstract)
W87-07535

FLUOROMETRIC DETERMINATION OF HYDROGEN PEROXIDE IN GROUNDWATER,
Illinois State Water Survey Div., Champaign.
T. R. Holm, G. K. George, and M. J. Barcelona.
Analytical Chemistry ANCHAM, Vol. 59, No. 4, p 582-586, February 1987. 1 fig, 2 tab, 38 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Hydrogen peroxide, *Groundwater, *Fluorometry, *On-site tests, Data acquisition, Calibrations, Fluorescence, Detection limits, Standard deviation, Pollutants, Chemical analysis.

The fluorometric scopoletin-horseradish peroxidase method was modified for field determinations of hydrogen peroxide concentrations in groundwaters. Standard additions calibration compensated for background fluorescence and inconsistent stoichiometry of the fluorescence quenching reaction due to interferences by the matrix. The detection limit, defined as the blank plus three standard deviations, ranged from 3.6 to 44.6 nM. However, this limit was more an indication of the difficulty of preparing peroxide-free water than the actual limit imposed by the sensitivity of the method for the peroxide contamination introduced with the reagents. For 111 field determinations the weighted average (uncorrected) hydrogen peroxide concentration was 20.2 nM and the pooled standard deviation was 7.7 nM. The average of 45 field blanks was 7.8 nM with a pooled standard deviation of 5.2 nM. At nanomolar concentration levels, it is essential that samples are analyzed for H2O2 in the field. Storage periods exceeding 1 hour caused serious errors and irreproducible results. (Author's abstract)
W87-07536

SPECIFICITY OF THE ION EXCHANGE/ATOMIC ABSORPTION METHOD FOR FREE COPPER(II) SPECIES DETERMINATION IN NATURAL WATERS,
Alberta Univ., Edmonton. Dept. of Chemistry.
J. A. Sweileh, D. Lucyk, B. Kratochvil, and F. F. Cantwell.
Analytical Chemistry ANCHAM, Vol. 59, No. 4, p 586-592, February 1987. 5 fig, 1 tab, 37 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Copper, *Ion exchange, *Spectral analysis, Data acquisition, Comparison studies, Chemical analysis, Ions, Cations, Interference, Hydrogen ion concentration, Trace levels, Acidic water, Organic carbon, Mathematical equations, Pollutants, Specificity.

Concentrations of the free copper(II) species (Cu(2+)) measured by the ion exchange/atomic absorption (IEX) method in the presence of various concentrations of the ligands citrate, glycinate, phthalate, salicylate, chloride, and fulvate are compared to concentrations measured with a cupric ion selective electrode (ISE) and/or to concentrations calculated from the known metal-ligand formation constants. The IEX method is considerably more sensitive for Cu(2+) than the ISE method but is subject to interference from cationic and neutral copper complexes as well as from filterable colloidal copper-hydroxo species at higher pH values. Accurate values of Cu(2+) concentration are obtained by both methods in the presence of anionic copper-ligand complexes. Since fulvate, which is the principal ligand present in natural freshwaters, forms anionic complexes, the IEX method possesses adequate selectivity for measuring Cu(2+) at trace levels in such waters. The complexing capacity of an acidic lake water with a very low dissolved organic carbon content was measured as 3.0 times 10 to the minus 8th power M by monitoring Cu(2+) concentration by the IEX method during titration with copper nitrate. (Author's abstract)
W87-07537

COMPREHENSIVE TRACE LEVEL DETERMINATION OF ORGANOTIN COMPOUNDS IN ENVIRONMENTAL SAMPLES USING HIGH-RESOLUTION GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION,
Station Federale de Recherches en Arboriculture, Viticulture et Horticulture de Waedenswil (Switzerland).
M. D. Muller.
Analytical Chemistry ANCHAM, Vol. 59, No. 4, p 617-623, February 1987. 6 fig, 5 tab, 44 ref.

Descriptors: *Analytical methods, *Sample preparation, *Pollutant identification, *Organotin compounds, *Gas chromatography, *Flame photometry, *Trace levels, Data acquisition, Chromatography, Tin, Mass spectrometry, Chemical analysis, Sediments, Sludge, Surface water, Pollutants.

A comprehensive method for trace analysis of mono-, di-, tri-, and some tetrasubstituted organotin compounds is presented. The ionic compounds are extracted from diluted aqueous solutions as chlorides by using a Tropolon-C18 silica cartridge and from sediment and sewage sludge by using an ethereal tropolon solution. The extracted organotin compounds are ethylated by a Grignard reagent and analyzed by using high-resolution gas chromatography with flame photometric detection (HRGC/FPD). Gas chromatography/mass spectrometry was used for confirmation. The extraction behavior, gas chromatographic retention, and photometric response of a series of organotin compounds are described, and the identification via electron impact and chemical ionization mass spectrometry is discussed. The main organotin compounds detected in various samples are butyltins; cyclohexyl- and phenyltins were identified in some of the sediment and sewage sludge samples. Methylbutyltins and tetrabutyltin were not detected. Concentrations were found to range from low ng/L (parts per trillion) in surface water to low mg/kg (parts per million) in sewage sludge. (Author's abstract)
W87-07538

FLUORIMETRIC DIFFERENTIAL-KINETIC DETERMINATION OF SILICATE AND PHOSPHATE IN WATERS BY FLOW-INJECTION ANALYSIS,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 7B.
W87-07569

5B. Sources Of Pollution

DRAINAGE WATER QUALITY FROM POTATO PRODUCTION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
K. L. Campbell, J. S. Rogers, and D. R. Hensel.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1798-1801, November-December 1985. 6 fig, 2 tab, 8 ref.

Descriptors: *Drainage, *Nitrogen, *Phosphorus, *Potatoes, *Water management, *Irrigation, *Water quality, Water table, Flow, Nutrients, Runoff, Food crops.

Nitrogen and phosphorus losses were measured from a sandy, high-water-table soil in Florida used for potato production under two water management systems. These were a water-furrow irrigation system with surface drainage only and a subsurface drainage-irrigation system with surface

runoff. Total flow volumes were very similar from both management systems. Subsurface drainage accounted for 80% of the water loss from that plot. Nitrate nitrogen and PO4-P losses were greater from the water-furrow plot than from the subsurface-drained plot. These results may have been influenced by the interactions of the controlled high water table and the raised row-beds with the water management systems. (Author's abstract)
W87-06641

SEDIMENT YIELD AND WATER QUALITY FROM A STEEP-SLOPE SURFACE MINE SPOIL,
Brown and Caldwell, Atlanta, GA.
For primary bibliographic entry see Field 2J.
W87-06647

NUMERICAL SIMULATION OF THE CONVECTIVE TRANSPORT OF A NONINTERACTIVE CHEMICAL THROUGH AN UNSATURATED/SATURATED POROUS MEDIA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
E. B. Richie, and J. R. Hoover.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1860-1866, November-December 1985. 7 fig, 2 tab, 13 ref, append.

Descriptors: *Model studies, *Groundwater movement, *Soil water movement, *Porous media, *Particle movement, *Path of pollutants, *Numerical simulation, *Convective transport, Computers, Velocity, Prediction, Flow, Moisture content, Hydraulic conductivity, Distribution.

A particle tracking model was developed to determine location, pathway, and arrival time of a noninteractive chemical as it migrates through a heterogeneous, anisotropic, saturated/unsaturated transient porous media. The model is capable of accurately simulating particle movement through a wide variety of subsurface configurations at relatively low computer costs. The computation speed allows for the selection of small time steps and the solution scheme can solve for a velocity vector at any location within the subsurface regime. This combination improves on the prediction of particle pathways by describing flow throughout the entire media, rather than depending on average values of flow velocity. Input for the model was the initial location of the chemical particle, moisture characteristic and hydraulic conductivity functions of each soil, and the total potential distribution. The velocity vector at the particle's exact internodal position is determined by a series of one-dimensional numerical solution schemes. The particle is then moved as a function of the interpolated velocity vector and the time step length. The accuracy of the model is tested by comparing the simulated results to analytical solutions of three subsurface flow problems. Examples of particle tracking through three hypothetical flow systems are presented to illustrate the usefulness and flexibility of the model. (Author's abstract)
W87-06651

BACTERIAL QUALITY OF RUNOFF FROM MANURED AND NON-MANURED CROPLAND,
Department of Agriculture, Ottawa (Ontario). Animal Research Centre.
N. K. Patni, H. R. Toxopeus, and P. Y. Jui.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1871-1877, 1884, November-December 1985. 1 fig, 9 tab, 29 ref.

Descriptors: *Bioindicators, *Runoff, *Bacteria, *Watersheds, *Land disposal, *Animal wastes, *Waste disposal, *Manure, *Water quality, Weather, Topography, Pollutants, Monitoring.

Indicator bacteria concentrations in non-snowmelt runoff from adjacent manured and non-manured watersheds were monitored for 4 years. Significant differences in the quality of runoff from the manured and non-manured cropland were not consistently observed. Hydrological conditions greatly affected bacterial concentrations. Heavy runoff under wet weather conditions resulted in water quality degradation irrespective of cropping or manuring activity. Under relatively dry weather conditions, runoff from both the manured and non-manured cropland often met the recommended bacterial quality criteria for water to be used for recreation or as a source of public water supplies. The relatively better quality of manured cropland runoff in our study compared to other studies was attributed mainly to the management practice of dry weather manure application followed by immediate plowdown and the mostly level topography of the watersheds. Much lower indicator bacteria concentrations in long-term stored manure than in relatively fresh manure suggested a lower potential for runoff pollution from land application of the former. (Author's abstract)
W87-06653

INSECTICIDE WASHOFF FROM COTTON PLANTS AS A FUNCTION OF TIME BETWEEN APPLICATION AND RAINFALL,
Agricultural Research Service, Oxford, MS.
L. L. McDowell, G. H. Willis, S. Smith, and L. M. Southwick.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1896-1900, November-December 1985. 2 fig, 6 tab, 22 ref, append.

Descriptors: *Insecticides, *Washoff, *Path of pollutants, *Cotton, *Rainfall, *Simulated rainfall, Pollution load, Methyl parathion, Toxaphene, Fenvalerate, Storms, Pest control, Prediction, Irrigation, Agriculture.

Methyl parathion (MP), toxaphene (TOX), and fenvalerate (FEN), as emulsifiable concentrates, were tank mixed with water and applied at 1.15 + 2.30 + 0.11 kg active ingredient/ha to cotton plants (triplicate plots) by ground equipment. Plant sampling showed that insecticide loads on the plants decreased hyperbolically with time. Simulated rainfall (51 mm) was applied at 53 mm/h to a new test plot at 2, 6, 29, 50, 98, and 146 h after insecticide application to determine the fractions of the insecticides washed from the plants. The fractions of MP washed from the plants decreased exponentially with time after application and linearly with load on the plants. In contrast to MP, the fractions of TOX and FEN washed from the plants were relatively constant at 10 and 7%, respectively, regardless of time after application and loads on the plants. About 50% of the MP, TOX, and FEN washed from the plants by any one storm was washed off by only 7 to 8 mm of rainfall, regardless of when rain occurred. This information will improve the accuracy of predictions made in mathematical simulations of foliar washoff and routing and may aid in developing guidelines for respraying for pest control following natural rainfall or overhead irrigation. (Author's abstract)
W87-06657

TRANSFER OF SOIL SURFACE-APPLIED CHEMICALS TO RUNOFF,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
G. C. Heathman, L. R. Ahuja, and O. R. Lehman.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1909-1915, 1920, November-December 1985. 9 fig, 2 tab, 16 ref.

Descriptors: *Model studies, *Infiltration, *Path of pollutants, *Potassium bromide, *Runoff, *Simulated rainfall, *Field tests, *Transport, Soil types, Soil water, Tillage effects, Clays, Loam, Adsorption, Salts, Soil solution.

Transport of Br(-) and K(+) in runoff from a soil surface-applied KBr solution was studied experimentally with simulated rainfall in soil boxes and grassed field plots. Two soil types, and four initial soil moisture levels were investigated in the soil boxes. In addition, the effect of a sorghum mulch cover was examined in one case. For both soils, the highest loss of Br(-) in runoff occurred from the initially wet soil moisture level. The mulch cover over an initially wet soil significantly reduced the amount of Br(-) in runoff as compared with the bare wet soil. The trend with K(+) was similar to that of Br(-), though the relative effects of initial soil moisture levels and tillage were less for K(+) than for Br(-). Furthermore, the relative effects of these factors were less in the clay loam soil which has a higher adsorption capacity for K(+) than in the sandy loam soil. The percentage of applied K(+) lost in runoff from soil boxes was much higher than that of Br(-) in all cases. A simplified nonuniform mixing model, which incorporates the effects of infiltration rates, was shown to reasonably predict Br(-) concentration in runoff. Total Br(-) loss in runoff from the field plots was much greater than from packed boxes of the same soil. This may be caused from the grass-covered surface of the plots retaining Br(-) loss and possibly because the net degree of mixing between rain water and soil solution with depth was greater in the field plots than in the boxes. With an adjustment for these parameters, the nonuniform mixing model described the results from four plots and two rain intensities fairly well. (Author's abstract)
W87-06659

MICROBIAL CONSUMPTION OF NITRIC AND SULFURIC ACIDS IN ACIDIFIED NORTH TEMPERATE LAKES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W87-06676

ROLE OF SULFATE REDUCTION IN LONG TERM ACCUMULATION OF ORGANIC AND INORGANIC SULFUR IN LAKE SEDIMENTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. M. Rudd, C. A. Kelly, and A. Furutani.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1281-1291, November 1986. 5 fig, 4 tab, 28 ref. NSERC (Canada) Grant A2671.

Descriptors: *Limnology, *Acid rain, *Acid lakes, *Lake sediments, *Biodegradation, *Sulfate reduction, *Isotope studies, *Path of pollutants, Sulfur compounds, Iron, Sediments, Lakes, Deposition, Accumulation.

Sulfate reduction and the accumulation of reduced sulfur in epilimnetic sediments were studied in lakes in southern Norway, the Adirondack Mountains, and at the Experimental Lakes Area (ELA) of northwestern Ontario. In all of the lakes, in addition to the previously known formation of acid volatile sulfur, sulfate reduction also produced substantial quantities of pyrite and organic sulfur compounds. In 9-month in situ experiments at ELA using 35S, there was a large loss (55%) with time of the S initially reduced and deposited in the sediments and a preferential loss of inorganic S compounds which led to a predominance of organic 35S accumulation in the sediments. An intensive study of long term accumulation of sulfur in the epilimnetic sediments of four Adirondack lakes also showed that the most important long term end product of sulfate reduction was organic S and that sulfate reduction was the major source of S to the sediments. Because of the high concentrations of iron in all of the sediments we sampled and because of the long term storage of sulfur in sediments, mostly as organic S, iron did not limit iron sulfide accumulation in these sediments. Iron limitation is unlikely to occur except in unusual circumstances. This study indicates that formation of organic S in epilimnetic sediments is primarily responsible for H(+) consumption via sulfate reduction in acidified lakes. (See also W87-06676) (Author's abstract)
W87-06677

TIME RESOLUTION METHODOLOGY FOR ASSESSING THE QUALITY OF LAKE SEDIMENT CORES THAT ARE DATED BY 137CS,
Department of Energy, New York. Environmental Measurements Lab.
K. M. Miller, and M. Heit.
Limnology and Oceanography LIOCAH, Vol. 31, No. 6, p 1292-1300, November 1986. 17 fig, 1 tab, 22 ref.

Descriptors: *Sediment cores, *Sampling, *Core samples, *Isotope studies, *Cesium-137, *Water

pollution sources, *Limnology, Deposition, Fallout, Sediments, Lakes, Profiles, History.

Lake sediment cores are used to reconstruct the history of the input of trace substances into the ecosystem. Local, regional, and global depositions have all been inferred from changes observed in the distribution of a given substance throughout a core. Currently, there is much interest in using this technique to reconstruct the history of acid precipitation in certain areas of the country. A methodology is proposed for grading the utility of lake sediment cores used to reconstruct pollution histories. The observed distribution of 137Cs with depth in the core is compared to that expected from independent, historic measurements of fallout deposition. The width of the 137Cs peak in the core profile that corresponds to the fallout maximum of 1963, or the combined maxima of 1959 and 1963, is used to infer the inherent time resolution of the core, i.e. the ability to distinguish events in the deposition history of the watershed. The method is applied to a number of core profiles from various lakes in the U.S. and appears to provide self-consistent results. (Alexander-PTT)
W87-06678

SIMULATION OF SALTWATER INTRUSION IN VOLUSIA COUNTY, FLORIDA,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 2F.
W87-06688

NUTRIENT LOADS TO WISCONSIN LAKES: PART I. NITROGEN AND PHOSPHORUS EXPORT COEFFICIENTS,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 2H.
W87-06690

NUTRIENT LOADS TO WISCONSIN LAKES: PART II. RELATIVE IMPORTANCE OF NUTRIENT SOURCES,
Rensselaer Polytechnic Inst., Troy, NY.
N. L. Clesceri, S. J. Curran, and R. I. Sedlak.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 991-1000, December 1986. 1 fig, 7 tab, 21 ref.

Descriptors: *Nutrients, *Nitrogen, *Phosphorus, *Wisconsin, *Lakes, *Eutrophication, *Limnology, Municipal wastewater, Nonpoint nutrient sources, Transport, Agriculture, Water quality, Distribution.

A comparison of municipal wastewater treatment plant (WWTP) and nonpoint source nutrient loads to Wisconsin's 14,927 inland lakes was performed. Only 65 of the 2,925 Wisconsin lakes having surface areas of at least eight ha and a maximum depth of at least 2.4 m had one or more WWTP's located within 40 km upstream; 99 of Wisconsin's 477 WWTP's were identified to be upstream of these 65 lakes. WWTP total nitrogen and total phosphorus loads to these 65 lakes were estimated using per capita influent loads and removal efficiencies based on wastewater treatment types. Nonpoint source nutrient loads were calculated utilizing nutrient export coefficients derived specifically for Wisconsin. Total nitrogen inputs to the lakes were dominated by nonpoint sources. The effectiveness of various phosphorus control programs to produce water quality improvements visible to the public was estimated to be as follows (going from most to least effective): municipal phosphorus removal and agricultural reductions, municipal phosphorus removal alone, agricultural reduction plus phosphate detergent ban, agricultural reductions alone, and phosphate detergent ban alone. The last option would not be expected to produce water quality improvement visible to the public in any Wisconsin lakes. The differences between the distributions in Wisconsin lakes. The differences between the distributions in Wisconsin of population and inland lakes highlights the need to consider regional characteristics in any statewide water quality management plan. (See also W87-06690) (Author's abstract)
W87-06691

RAINOUT LIFETIMES OF HIGHLY SOLUBLE AEROSOLS AND GASES AS INFERRED FROM SIMULATIONS WITH A GENERAL CIRCULATION MODEL,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2B.
W87-06697

LAGRANGIAN TIME SCALES CONNECTED WITH CLOUDS AND PRECIPITATION,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 2B.
W87-06698

NUMERICAL MODEL FOR SULFUR AND NITROGEN SCAVENGING IN NARROW COLD-FRONTAL RAINBANDS: 1. MODEL DESCRIPTION AND DISCUSSION OF MICROPHYSICAL FIELDS,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W87-06699

CONSIDERATIONS REGARDING SOURCES FOR FORMIC AND ACETIC ACIDS IN THE TROPOSPHERE,
Virginia Univ., Charlottesville. Div. of Urban and Environmental Planning.
For primary bibliographic entry see Field 2B.
W87-06702

NITROGEN TRANSFORMATIONS IN PONDS RECEIVING POLLUTED WATER FROM NON-POINT SOURCES,
North Carolina Agricultural and Technical State Univ., Greensboro.
G. B. Reddy, and K. R. Reddy.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 1-5, January-March 1987. 4 fig, 3 tab, 29 ref.

Descriptors: *Isotope studies, *Path of pollutants, *Ammonium removal, *Nitrogen, *Ponds, *Fate of pollutants, *Nonpoint pollution sources, Effluents, Sediments, Diffusion, Agricultural runoff, Watersheds, Septic tanks.

A laboratory study was conducted to determine the role of N transformations in ponds receiving inorganic N-rich effluents from septic fields, agricultural, and pasture watersheds. Undisturbed sediment columns were obtained from three ponds. Floodwater in the columns was enriched with either 15NH4(+)-N or 15NO3(-)-N. Ammonium removal rates ranged from 55 to 85 mg N/sq m/d, while NO3(-)-N removal rates ranged from 48 to 71 mg N/sq m/d. Twenty-three to 49% of floodwater 15NH4(+)-N diffused into the sediment during a 22-d incubation period and was recovered in 15NH4(+)-N (6-12% of the floodwater 15NH4(+)-N) and organic 15N fractions (14-37% of the floodwater 15NH4(+)-N). When 15NO3(-)-N was added to the floodwater, about 7% was tied up in the sediment. Ponds receiving effluents from septic tanks and pastured areas retained less floodwater N in the sediment compared to sediments of the pond receiving runoff from agricultural watershed. (Author's abstract)
W87-06717

NITRATE LEACHING AND DRAINAGE FROM ANNUAL AND PERENNIAL CROPS IN TILE-DRAINED PLOTS AND LYSIMETERS,
Sveriges Lantbruksuniversitet, Umea.
L. Bergstrom.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 11-18, January-March 1987. 5 fig, 2 tab, 24 ref.

Descriptors: *Groundwater, *Path of pollutants, *Nitrates, *Leaching, *Tile drainage, *Lysimeters, Fertilizers, Agriculture, Weather, Soil profiles, Estimating.

Leaching of NO3 with drainage water from tile-drained field plots and from three types of lysimeters was estimated during a 4-yr period. Treatments included barley (Hordeum distichum L.) with and without N-fertilizer, a grass ley (Festuca pratensis), and a lucerne ley (Medicago staiva)(i.e., 4-yr forage crops). The maximum amount of NO3 leached was 36 kg N/ha/yr for barley fertilized with Ca(NO3)2 (120 kg N/ha/yr). For unfertilized barley the corresponding amount was 5 kg N/ha during the same period. The NO3 fluxes from the grass and lucerne leys were mostly below 5 kg N/ha/yr. However, after the grass ley was plowed, considerable leaching occurred, reaching 42 kg N/ha during 20 weeks following plowing. Weather conditions had a strong influence on the temporal distribution of leaching losses. Lysimeters, compared with tile-drained plots, had generally higher drainage volumes. The slow dynamics of groundwater beneath the drainage-tiles can explain most of this difference. Lysimeters with disturbed soil profiles usually had higher drainage volumes than lysimeters with undisturbed profiles. Despite these differences, all methods consistently estimated the relative differences between the cropping systems concerning leaching of NO3. The degree of variation in drainage flow between lysimeter replicates was also satisfactorily low. (Author's abstract)
W87-06719

MINERALIZATION AND VOLATILIZATION OF POLYCHLORINATED BIPHENYLS IN SLUDGE-AMENDED SOILS,
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
B. C. Fairbanks, G. A. O'Connor, and S. E. Smith.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 18-25, January-March 1987. 1 fig, 5 tab, 37 ref. DOE Contract DE-AC04-83AL21776.

Descriptors: *Fate of pollutants, *Sludge disposal, *Land disposal, *Waste disposal, *Mineralization, *Volatilization, *Polychlorinated biphenyls, *Path of pollutants, Transport, Isotope studies, Soil types, Sludge, Degradation.

Polychlorinated biphenyls (PCBs) are toxic organics of concern limiting the reuse of sewage sludge on agricultural lands. The mineralization and volatilization of PCBs (14C-Aroclor 1254) were monitored for 240 d in three calcareous soils from New Mexico, amended or unamended with sewage sludge. Two first-order rate constants were used to describe both processes and to compare treatment effects of sludge addition, PCB concentration (5, 50, 500 mg/kg), soil textural class, and length of sludge incubation with soils prior to experimentation. Total loss of PCBs ranged from 8 to 33%. Fifty and 95% disappearance times ranged from 2.5 to 5.9 yr and 6.1 to 26.3 yr, respectively. Treatment effects on total loss closely paralleled those of volatilization. Volatilization of organics ranged from 5 to 31%, and was the major means of loss of 14C in unamended soils and all 500 mg PCB/kg treatments. Volatilization, and thus environmental transport, was decreased by sludge addition. Exposure of the soil to sludge prior to experimentation had no effect on volatilization when compared to fresh sludge additions. Carbon-14-organic volatile loss was greater in two sandy loams than in a clay soil. Comparing PCB concentrations, volatilization was generally greatest at 50 mg/kg and least at 500 mg/kg, with comparatively smaller differences between 5 and 50 mg/kg. Degradation of 14C-Aroclor 1254 to 14CO2 ranged from 1 to 11%. Overall, 14CO2 evolution, and thus detoxification increased with sewage sludge addition and decreased with increasing PCB concentration. Mineralization exceeded volatilization in sludge-amended soils at 5 mg PCBs/kg. During the first 60 d of incubation, previous exposure of the soil to sewage sludge increased mineralization in the 5 and 50 mg PCB/kg treatments. In no case did sewage sludge additions increase the environmental hazard of Aroclor 1254 in these soils. (Author's abstract)
W87-06720

DECOMPOSITION OF FRESH AND ANAEROBICALLY DIGESTED PLANT BIOMASS IN SOIL,
Florida Univ., Gainesville. Dept. of Soil Science.

K. K. Moorhead, D. A. Graetz, and K. R. Reddy.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 25-28, January-March 1987. 2 fig, 5 tab, 18 ref.

Descriptors: *Isotope studies, *Anaerobic digestion, *Biomass, *Degradation, *Fate of pollutants, *Water hyacinth, *Land disposal, *Soil amendments, *Mineralization, Nutrients, Nitrogen, Carbon, Incubation, Moisture content, Sludge, Kinetics, Waste disposal.

Fresh and anaerobically digested water hyacinth biomass, with either low or high N tissue content, were added to soil to evaluate C and N mineralization characteristics. The plant biomass was labeled with 15N before digestion. The fresh plant biomass and digested biomass sludge were freeze-dried and ground to pass a 0.84-mm sieve. The materials were thoroughly mixed with a Kindrick fine sand (Arenic Paleudults) at a rate of 5 g/kg soil and incubated for 90 d at 27 C at a moisture content adjusted to 0.01 MPa. Decomposition was evaluated by CO2 evolution and 15N mineralization. After 90 d, approximately 20% of the added C of the digested sludges had evolved as CO2 compared to 39 and 50% of the added C of the fresh plant biomass with a low and high N content, respectively. First-order kinetics were used to describe decomposition stages. Mineralization of organic 15N to 15NO3(-)-N accounted for 8% of applied N for both digested sludges at 90 d. Nitrogen mineralization accounted for 3 and 33% of the applied organic N for fresh plant biomass with a low and high N content, respectively. (Author's abstract)
W87-06721

METAL ACCUMULATION IN CORN AND BARLEY GROWN ON A SLUDGE-AMENDED TYPIC OCHRAQUALF,
Kearney (A.T.), Inc., Alexandria, VA.
B. D. Rappaport, D. C. Martens, R. B. Reneau, and T. W. Simpson.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 29-33, January-March 1987. 1 fig, 6 tab, 40 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Corn, *Barley, *Soil amendments, *Land disposal, *Sludge disposal, *Waste disposal, *Path of pollutants, Soil types, Anaerobic digestion, Silage, Soil horizons, Soil profiles, Phytotoxicity.

A field experiment was conducted during the 1984 and 1985 growing seasons in the Atlantic Coastal Plain region to evaluate heavy metal accumulation in corn (Zea mays L.) grain and stover and in barley silage (Hordeum vulgare L.) grown on a poorly drained, sludge-amended soil. The study was conducted using in situ controlled lateral flow plots (1.5 by 2.3 m) on Acredale silt loam (fine-silty, mixed, thermic, Typic Ochraqualfs) with a cation exchange capacity of 6.9 mol sub c/kg and a pH of 6.6. An aerobically digested sludge from a wastewater treatment plant with major industrial inputs was applied to the plots in 1984 at rates of 0, 42, and 84 dry Mg/ha. At the highest application rate, 1.8, 304, 17.2, and 248 kg/ha of Cd, Cu, Ni, and Zn were applied, respectively. Cadmium concentration was <0.01 mg/kg in the corn grain in both 1984 and 1985. Sludge application increased the concentration of Ni and Zn in the corn grain in 1984 and 1985. Levels of Cd and Cu were unaffected by sludge application in the corn grain for both years. Copper, Ni, and Zn levels were increased in the barley silage by sludge application. Levels of DTPA (diethylenetriaminepentaacetic acid)-extractable metal in the Ap horizon were increased by sludge application and were 0.25, 60, 2, and 30 mg Cd, Cu, Ni, and Zn/kg in the highest sludge treatment, respectively. The DTPA-extractable Cd, Cu, Ni, and Zn within the soil profile indicated no downward metal movement. On this poorly drained soil, phytotoxicity due to metals did not occur even where Cu was applied in excess of 280 kg/ha, which is the maximum amount of Cu that could be applied to the soil based on USEPA guidelines. (Author's abstract)
W87-06722

NITRATE LEACHING LOSSES FROM MONOLITH LYSIMETERS AS INFLUENCED BY NITRAPYRIN,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 34-38, January-March 1987. 5 fig, 2 tab, 14 ref.

Descriptors: *Lysimeters, *Corn, *Path of pollutants, *Nitrates, *Leaching, *Nitrapyrin, *Urea, Fertilizers, Nitrification, Inhibition, Seasonal variation, Groundwater.

Three monolith lysimeters, each with a surface area of 8.1 sq m and a depth of 2.4 m, were planted to no-till corn (Zea mays L.) for 6 consecutive years. The lysimeters contained a Rayne silt loam (Typic Hapludult), a well-drained residual soil. Urea was placed in a slot approximately 10-cm deep and 10 to 15 cm from the corn row at a rate of 336 kg N/ha. The urea applied to two of the lysimeters was treated with nitrapyrin (2-chloro-6-(trichloromethyl)pyridine), a nitrification inhibitor, and applied untreated on the third lysimeter. Two years of unfertilized meadow immediately preceded the corn. Concentrations of NO3(-)-N in the leachate from the lysimeters were higher during the corn years than during the meadow period. Concentrations showed seasonal variations during the last 3 yr of the study, but showed no increasing trend. The leachate from the lysimeters receiving the nitrapyrin treated urea had seasonally flow-weighted NO3(-)-N concentrations ranging from 6 to 40 mg/L, while the leachate from the lysimeter receiving untreated urea had seasonally flow-weighted NO3(-)-N concentrations ranging from 20 to 54 mg/L. Nitrate-N losses showed a similar treatment difference. The 6-yr annual average NO3(-)-N loss was 117 and 160 kg/ha from the lysimeters with the treated urea and untreated urea, respectively. This study demonstrates that nitrification inhibitors such as nitrapyrin, have a potential to reduce NO3(-)-N leaching when applied with ammoniacal fertilizers. (Author's abstract)
W87-06723

RESIDUAL PESTICIDE CONCENTRATIONS IN BEAR CREEK, MISSISSIPPI, 1976 TO 1979,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. M. Cooper, F. E. Dendy, J. R. Mc Henry, and J. C. Ritchie.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 69-72, January-March 1987. 2 fig, 3 tab, 15 ref.

Descriptors: *Path of pollutants, *Pesticides, *Bear Creek, *DDT, *DDE, *Toxaphene, *Runoff, *Sediments, Surface water, Lakes, Streams, Watersheds, Erosion, Mississippi River.

Concentrations of DDT (1,1,1-trichloro-2,2-bis(p-chlorophenyl)-ethane), DDE (1,1-dichloro-2,2-bis(p-chlorophenyl)-ethane), and toxaphene (chlorinated camphene) were measured in surface waters, soils, storm runoff, and deposited bottom sediments along the 83-km length of Bear Creek. This creek is a Mississippi River alluvial stream, which includes six riverine lakes in an intensively cultivated 44260-ha watershed. Low concentrations of pesticides were persistent in surface waters of the creek from the headwaters to the confluence with the Yazoo River with no significant differences in concentrations between sites on the creek or in isolated offstream lakes. Pesticide concentrations increased during periods of maximum runoff, which corresponded with the winter rainy season and minimum vegetative cover on the soil. Seven years after spraying had ceased, DDT was still available to surface waters and aquatic biota by way of eroded soil from farm fields and from deposited sediments in stream and lake bottoms. No significant declines in concentrations of DDT in surface waters were found in comparisons with two earlier studies nor were any declines in surface water contamination noted during this 3-yr study. (Author's abstract)
W87-06726

SHORT-TERM VARIABILITY IN BIOGENIC SULPHUR EMISSIONS FROM A FLORIDA SPARTINA ALTERNIFLORA MARSH,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
D. J. Cooper, W. Z. de Mello, W. J. Cooper, R. G. Zika, and E. S. Saltzman.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 7-12, January 1987. 3 fig, 2 tab, 19 ref. NSF Grant ATM 84-05921.

Descriptors: *Temporal variation, *Salt marshes, *Air pollution sources, *Acid rain, *Florida, *Spartina, *Sulfur emissions, *Acid rain, Sulfur compounds, Sulfur, Tidal effects, Tides, Temperature, Sediments, Atmosphere.

Recent studies on the problem of acid precipitation have focused largely on the biogeochemical cycling of sulfur-containing compounds. The contribution of biogenic reduced S gases to the atmospheric S burden has been and remains an area of major concern. Emissions of biogenic sulfur gases from a Florida Spartina alterniflora zone were measured over several tidal and diel cycles using a dynamic flow chamber technique, corroborating recently published information. The flux of hydrogen sulfide from individual measurements is shown to vary by over four orders of magnitude, and correlates primarily with the stage of the tidal cycle. In contrast, the fluxes of dimethyl sulfide, carbon disulfide and dimethyl disulfide vary by less than an order of magnitude and correlate primarily with the diurnal temperature changes in the sediment surface. These differences are discussed in terms of the various biological and physical parameters which may regulate the release of reduced sulfur compounds to the atmosphere. (Alexander-PTT)
W87-06740

ANTHROPOGENIC NITROGEN OXIDE TRANSPORT AND DEPOSITION IN EASTERN NORTH AMERICA,
Massachusetts Inst. of Tech., Cambridge. Energy Lab.
J. A. Fay, D. Golomb, and S. Kumar.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 61-68, January 1987. 6 fig, 2 tab, 15 ref.

Descriptors: *Model studies, *Nitrogen oxides, *Atmospheric transport, *Path of pollutants, *Nitrates, *Deposition, *Precipitation, *Acid rain, Winds, Prediction, Transformation, Anthropogenic pollution sources, Optimization, Calibrations, Estimating.

A long-range atmospheric transport and transformation model is presented for nitrogen oxides emitted by man-made sources. The model parameters are optimized by matching the model output-annual average nitrate (NO3(-)) wet deposition-to observed deposition at 109 precipitation sampling stations in eastern North America that operated continuously in the years 1980-1982. The root-mean-square residual between observations and predictions is 2.9 kg NO3(-)/ha/y or 19.7% of the root-mean-square observed value. The trend of estimated annual average NO3(-) concentrations in precipitation at Hubbard Brook, New Hampshire compared well with the observations from 1964 to 1981. Transfer coefficients decay nearly exponentially with distance with length scales of 200-800 km, depending on source-receptor orientation with respect to the resultant annual wind direction. The model was used for source apportionment of NO3(-) wet deposition at several receptors and for estimating a nitrogen budget for eastern N America, including the transboundary fluxes between the U.S. and Canada. (Author's abstract)
W87-06741

WASHOUT RATIOS OF NITRATE, NON-SEA-SALT SULFATE AND SEA-SALT ON VIRGINIA KEY, FLORIDA AND ON AMERICAN SAMOA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
D. L. Savoie, J. M. Prospero, and R. T. Nees.
Atmospheric Environment ATENBP, Vol. 21, No.

1, p 103-112, January 1987. 2 fig, 3 tab, 27 ref. NSF Grants OCE-84-5609 and ATM-83-11335.

Descriptors: *Washout, *Sodium, *Path of pollutants, *Acid rain, *Nitrates, *Sulfates, *Virginia Key, *Samoa, *Precipitation, Aerosols, Temporal variation, Seasonal variation, Deposition, SEAREX, Florida.

On Virginia Key, Miami, Florida, 257 rainwater samples were collected on a event basis from May 1982 to April 1985. At the same site, 171 aerosol samples were collected throughout 1984. All of these samples were analyzed for nitrate, non-sea-salt (NSS) sulfate and sodium to assess the temporal variations in the concentrations and to determine the washout ratios of each of the constituents. The annual volume-weighted mean concentrations in rainwater are: nitrate-0.51 microgram(ug)/ml; NSS sulfate-0.74 ug/ml; Na-1.93 ug/ml. Only sodium exhibited a significant seasonal cycle; its concentrations were markedly higher during the winter. In aerosols, the mean concentrations are: nitrate-1.9 ug/cu m; NSS sulfate-2.8 ug/cu m; Na-3.7 ug/cu m. Nitrate and NSS sulfate exhibit consistent seasonal cycles with concentrations being significantly higher during the winter and spring. It is estimated that wet deposition accounts for the majority of the total fluxes of each constituent: 80% for nitrate, 95% for NSS sulfate, and 67% for Na. Annual washout ratios at Virginia Key are similar for nitrate and NSS sulfate, 330 and 290, respectively. That for Na is about a factor of two higher, 550. Comparable long-term ratios were calculated for American Samoa based on aerosol data from the SEAREX program and rainwater data from the National Atmospheric Deposition Program: 270 for nitrate, 420 for NSS sulfate, and 520 for Na. The comparability of the Virginia Key and Samoa results suggest that these ratios may be applicable over a wide area of the world ocean. Estimates from nonconcurrent data for the washout ratio vs event rainfall (log W = log a + b log R) at Virginia Key were essentially the same for all three constituents with 'a' ranging from 1100 to 1300 and 'b' ranging from -0.26 to -0.29. The coefficients for American Samoa were markedly different: 'a' ranged from 2900 to 3600 and 'b' ranged from -0.51 to 0.56. (Author's abstract)
W87-06742

STATISTICAL SUMMARY AND ANALYSES OF EVENT PRECIPITATION CHEMISTRY FROM THE MAP3S NETWORK, 1976-1983,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
For primary bibliographic entry see Field 2B.
W87-06743

SPATIAL AND HISTORICAL TRENDS IN ACIDIC DEPOSITION: A GRAPHICAL INTERSITE COMPARISON,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
E. R. Altwicker, and A. H. Johannes.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 129-135, January 1987. 4 fig, 1 tab, 23 ref.

Descriptors: *Chemistry of precipitation, *Regional analysis, *Acidic deposition, *Path of pollutants, *Acid rain, *Precipitation, Ions, Spatial distribution, History, Comparison studies, Weather data collections.

Precipitation chemistry from different regions of the Continental United States is characterized in terms of a graph of annual mean Sigma(+) vs Sigma(-), where Sigma(+) = Ca(2+) + Mg(2+) + NH4(+) + K(+) and Na(+), and Sigma(-) = SO4(2-) + NO3(-) + Cl(-); concentrations are given in microequiv/L. Sites receiving acid precipitation (pH <4.5) tend to lie below a slope of 0.5 on such a graph, whereas sites that receive a (H(+)) <31.6 microequiv/L (i.e pH >4.5) tend to cluster near a line of slope one. Four regions, North Central (Minnesota, Wisconsin), Midwest (Illinois, Ohio), East Central (North Carolina, Virginia), and North East (Pennsylvania, New York, Vermont, New Hampshire, Maine) are areas of minimum and maximum Sigma(+) and Sigma(-) values. Seasonal variations of Sigma(+) and Sigma(-) tend to occur along lines of constant slope within these regions. The results from the last decade have been compared with the few measurements from the 1950s. Although one possible interpretation from this comparison is that Sigma(-) has increased in one or more of the regions considered, this view is tempered by the inherent difficulty in comparing single sites with regions. (Author's abstract)
W87-06744

DIFFERENCE BETWEEN SO4(2-) AND NO3(-) IN WINTERTIME PRECIPITATION,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 2B.
W87-06745

MARBLE WEATHERING AND AIR POLLUTION IN PHILADELPHIA,
Delaware Univ., Newark. Dept. of Geography.
For primary bibliographic entry see Field 5C.
W87-06746

DEGRADATION OF PARATHION IN CULTURES OF THE MARINE DINOFLAGELLATE POROCENTRUM MICANS E,
Paris-6 Univ. (France). Dept. de Biologie Cellulaire.
P. Prevot, and M. O. Soyer-Gobillard.
Water Research WATRAG, Vol. 21, No. 1, p 19-23, January 1987. 7 fig, 1 tab, 16 ref. DRET Agreement 84198.

Descriptors: *Organophosphorus pesticides, *Biodegradation, *Pesticides, *Parathion, *Insecticides, *Fate of pollutants, *Dinoflagellates, *Degradation, Cultures, Toxicity, Phytoplankton, Population exposure.

Organophosphorus pesticides are being used more and more, often instead of organochlorine pesticides that decompose slowly and can accumulate in living organisms. Parathion is one of the most commonly used organophosphorus insecticides and also one of the most toxic. The rate of degradation of parathion in laboratory cultures of a unicellular phytoplankton dinoflagellate, Prorocentrum micans E., was studied in conditions resembling the marine environment. When the parathion, at 1-5 ppm, was added in sterile culture medium there was no significant degradation after 2 months, whereas in the presence of populations of P. micans more than 95% was degraded in 10 days. The initial step of the biodegradation was a reduction to aminoparathion. This process corresponds to a detoxification of the medium. (Alexander-PTT)
W87-06750

VIRUS SURVIVAL ON VEGETABLES SPRAY-IRRIGATED WITH WASTEWATER,
Fairfield Hospital for Communicable Diseases (Australia). Virus Lab.
B. K. Ward, and L. G. Irving.
Water Research WATRAG, Vol. 21, No. 1, p 57-63, January 1987. 5 tab, 22 ref.

Descriptors: *Viruses, *Wastewater irrigation, *Impaired water use, *Survival, *Pollutant identification, *Irrigation, Wastewater, Food crops, Cultures, Isolation, Sample preservation, Vegetables.

A method, developed to detect low concentrations of virus on vegetables, irrigated with wastewater, was investigated in the field. Celery, spinach, lettuce and tomato crops, grown at an experimental station near Melbourne, Victoria, were spray-irrigated with stored wastewater, which had been seeded with either poliovirus or adenovirus. At specified intervals after irrigation, vegetables were harvested, washed to remove virus and the washings concentrated into a small volume which was inoculated into cell cultures for virus isolation. The method demonstrated rapid inactivation, within 48 h, of poliovirus on crops and low level persistence of this virus for up to 13 days. Adenovirus could not be detected on a lettuce crop as early as 24 h after irrigation. On crops harvested immediately after irrigation and stored at 4 C in a humid atmosphere in the dark, the method was able to demonstrate more gradual inactivation of poliovirus than under field conditions and virus persistence for up to 76 days. Since seeded virus concentrations were similar to those commonly detected in wastewater before storage, results indicate that this is a practical method for assessing viral contamination of vegetable crops spray-irrigated with wastewater. (Author's abstract)
W87-06755

TRACE METALS AND WATER CHEMISTRY OF FOREST LAKES IN NORTHERN SWEDEN,
National Swedish Environment Protection Board, Solna.
H. Borg.
Water Research WATRAG, Vol. 21, No. 1, p 65-72, January 1987. 8 fig, 7 tab, 22 ref.

Descriptors: *Forest lakes, *Lakes, *Water chemistry, *Trace metals, *Acid rain, *Acid lakes, *Sweden, *Pollutant identification, Water quality, Ions, Heavy metals, Electrolytes, Deposition, Spatial distribution, Regression analysis, Seasonal variation.

To study the influence of airborne pollutants on water quality, water samples were taken from 59 forest lakes in northern Sweden along a section of about 1000 km in length. Determinations were made of pH, water color, conductivity, major ions, nitrogen and phosphorus, as well as the metals Fe, Mn, Al, Zn, Cu, Pb, Cd, Ni, Cr, Co, As and V. The lake waters were generally soft, with low levels of electrolytes. The pH values increased and the sulfate concentrations decreased from south to north. The lakes in the southern parts of the area showed evidence of increased deposition of acidifying substances, shown by higher Ca + Mg/alkalinity ratio. A geographical distribution pattern was observed from Zn and to some extent also for Pb and Cd, with the highest concentrations in the south. However, pH and water color were of major importance for the distribution of trace metals. Mn, Al and Zn were negatively correlated to pH and Fe, Mn, Al, Pb and As were positively correlated to water color. A multiple regression analysis showed that the distribution of Fe was influenced mainly by water color, Zn mainly by pH, while Mn and Al were influenced both by pH and color. Some of the lakes were sampled both in winter and summer and the concentration of metals was found to be around two-fold higher in winter than in summer. (Author's abstract)
W87-06756

INFLUENCE OF CATION ACIDS ON DISSOLVED HUMIC SUBSTANCES UNDER ACIDIFIED CONDITIONS,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
C. Steinberg, and W. Kuhnel.
Water Research WATRAG, Vol. 21, No. 1, p 93-98, January 1987. 6 fig, 18 ref. German Umweltbundesamt UFO-KAT Wasser 102 04 333.

Descriptors: *Chemical reactions, *Acidified lakes, *Humic acids, *Acid rain effects, *Cation acids, *Aluminum, Transparency, Lakes, Ultraviolet absorption, Coprecipitation, Acids, Spectral analysis, Chromatography, Metals, Solutions.

Acidification of dilute lakes often leads to increase in transparency. The main reason is thought to be the input of cation acids, mainly inorganic aluminum species. Aluminum affects dissolved humic substances in two ways: (1) coprecipitation of dissolved humic substances with high u.v.-absorption and (2) cleavage of high molecular matter. Cleavage products possess a minor specific u.v.-absorption at 254 nm. (Author's abstract)
W87-06759

BIOACCUMULATION OF ZINC IN TWO FRESHWATER ORGANISMS (DAPHNIA MAGNA, CRUSTACEA AND BRACHYDANIO RERIO, PISCES),
Technische Hochschule Aachen (Germany, F.R.).

Lehrstuhl fuer Biologie 5.
U. Memmert.
Water Research WATRAG, Vol. 21, No. 1, p 99-106, January 1987. 5 fig, 1 tab, 73 ref.

Descriptors: *Path of pollutants, *Bioindicators, *Bioaccumulation, *Daphnia, *Zinc, *Toxicity, *Food chains, *Brachydanio, Fish, Crustaceans, Heavy metals, Diets, Metals.

Daphnia magna and Brachydanio rerio are important test organisms in toxicity tests. The bioaccumulation of zinc in these species was investigated in two semistatic experiments in synthetic freshwater with a zinc concentration of 250 microgram/L. Fishes were fed with polluted or unpolluted Daphnia magna to determine the significance of zinc accumulation from contaminated natural food. Daphnia magna accumulates zinc to a high extent within days. Uptake from food particles substantially contributes to the zinc accumulation in filter-feeding Daphnia; their zinc content strongly depends on the total but not on the dissolved zinc concentration in water. Zinc concentration of Brachydanio rerio increases only to a small extent during the 5 weeks accumulation time. They accumulate no additional zinc from the food source. In unpolluted and polluted Brachydanio a significant negative correlation exists between whole body zinc concentration and body dry weight. (Author's abstract)
W87-06760

CONSEQUENCES ASSOCIATED WITH A CRUDE PETROLEUM LEAK FROM A PIPELINE,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Journal of Environmental Management JEVMAW, Vol. 23, No. 3, p 247-257, October 1986. 1 fig, 1 tab, 23 ref. NSEC (Canada) Grant A3711.

Descriptors: *Oil pollution, *Pipelines, *Path of pollutants, *Water pollution effects, *Water quality management, Conveyance structures, Oil industry, Water quality control, Water pollution, Potable water, Environmental effects, Environmental policy, Environmental quality, Saint Lawrence River, Canada, Physicochemical properties, Drinking water, Surface water, Subsurface water.

The problem of managing potable water resources was presented and the impacts of these resources resulting from the transportation of oil by pipeline were described. The repercussions on potable water sources of the construction and operation of a pipeline on the south shore of the Saint Lawrence River, Quebec, Canada were evaluated. In this region, potable water sources serve both human and animal needs, as well as those of a large food industry. After establishing the importance of the problem and pointing out the physicochemical quality of the surface and subterranean waters used as drinking water in the region, the possible consequences of water source contamination from a crude petroleum leak were evaluated. (Author's abstract)
W87-06787

SOLUTE TRANSPORT THROUGH A STONY SOIL,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2G.
W87-06796

METHOD OF ESTIMATING THE TRAVEL TIME OF NONINTERACTING SOLUTES THROUGH COMPACTED SOIL MATERIAL,
Iowa State Univ., Ames. Dept. of Agronomy.
R. Horton, M. L. Thompson, and J. F. McBride.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 48-53, January-February 1987. 6 fig, 4 tab, 16 ref. EPA Assistance agreement CR-811093-01-0.

Descriptors: *Mathematical studies, *Path of pollutants, *Solute transport, *Compacted soil, *Porosity, *Hydraulic conductivity, *Permeability coefficient, Prediction, Soil water, Flow, Pores, Density, Soil properties, Soil types, Porosimeters, Solutes, Transport, Estimating, Breakthrough.

The pollutant travel time through compacted soil material (i.e., when a pollutant introduced at the top first appears at the bottom) cannot be accurately predicted from the permeability (saturated hydraulic conductivity) alone. The travel time is also dependent on the effective porosity of the material; i.e., the portion of the total porosity that contributes significantly to fluid flow. Once permeability and effective porosity are determined for a selected material, the travel time of noninteracting pollutants through specified thicknesses of compacted material at specified hydraulic gradients can be predicted easily. Pollutant travel time is directly proportional to effective porosity and thickness of a compacted layer and inversely proportional to permeability and hydraulic gradient. A straightforward method of determining the effective porosity of compacted soil materials is presented. The determination of effective porosity is based upon the total porosity and the spread on a log scale in the pore sizes of a compacted sample. The total porosity is calculated from measurements of bulk and particle density. Pore size distribution information is obtained from the cumulative porosity curve of the sample as measured by a mercury-intrusion porosimeter. Once the total porosity and pore size distribution information are obtained for a particular sample, the effective porosity can be determined directly by using a graphical relationship. This paper also compares measured and predicted solute breakthrough times for three compacted soil materials. Predicted travel times through compacted samples of glacial till, loess, and paleosol materials were reasonably close to measurements of Cl(-) travel time. (Author's abstract)
W87-06798

X-RAY PHOTOELECTRON STUDIES OF ANION ADSORPTION ON GOETHITE,
University of Western Ontario, London. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-06799

ESTIMATION OF DISPERSION AND FIRST-ORDER RATE COEFT BY NUMERICAL ROUTING,
Geological Survey, NSTL Station, MS.
H. E. Jobson.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 169-180, January 1987. 8 fig, 4 tab, 35 ref.

Descriptors: *Path of pollutants, *Pollutant transport, *Numerical analysis, *Model studies, *Rate coefficients, *Dispersion, *Convection, *Mathematical equations, *Streams, *Numerical routing, Transport, Reaction coefficients, Steady flow, Flow.

A study was conducted to demonstrate that the numerical routing procedure can produce realistic estimates of dispersion and first order reaction coefficients from observed data in rivers. It is shown that a Lagrangian model can be used to determine realistic estimates of dispersion and reaction coefficients using of the routing method. The numerical routing procedure was tested using data obtained analytically, under steady flow in a large (Missouri River) and small (Black Earth Creek, Wisconsin) river, in a channel with unsteady flow (Madison Effluent Channel) and in a river with steady but highly nonuniform flow conditions (West Fork Trinity River near Fort Worth, Texas). The numerical routing procedure based on a Lagrangian solution scheme performed well in all cases while offering the flexibility that only a numerical solution scheme can offer. The numerical routing procedure also allows the coefficient to be expressed as a complex but physically realistic expression instead of simply reach-averaged values. (Peters-PTT)
W87-06827

COMPOSITIONAL MULTIPHASE MODEL FOR GROUNDWATER CONTAMINATION BY PETROLEUM PRODUCTS: 1. THEORETICAL CONSIDERATIONS,
City Coll., New York. Dept. of Civil Engineering.
M. Y. Corapcioglu, and A. L. Baehr.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 191-200, January 1987. 2 fig, 1 tab, 56 ref. NSF Grant CEE-8401438, ACS/PRF 15890-AC5 and DOI G-897/02.

Descriptors: *Groundwater pollution, *Model studies, *Fate of pollutants, *Path of pollutants, *Petroleum products, *Hydrocarbons, *Biodegradation, Solute transport, Transport, Adsorption, Plumes, Gasoline, Underground storage, Prediction, Equations.

A mathematical model was developed to describe the fate of hydrocarbon constituents of petroleum products introduced to soils as an immiscible liquid from sources such as leaking underground storage tanks and ruptured pipelines. The problem is one of multiphase transport (oil(immiscible), air, and water phases) of a reactive contaminant with constituents such as benzene, toluene, and xylene found in refined petroleum products like gasoline. In the unsaturated zone, transport of each constituent can occur as a solute in the water phase, vapor in the air phase, and as an unaltered constituent in the oil phase. Additionally, the model allows for adsorption. Molecular transformations, microbially mediated or abiotic, are incorporated as sink terms in the conservation of mass equations. An equilibrium approximation, applicable to any immiscible organic contaminant was applied to partition constituent mass between the air, oil, water, and adsorbed phases for points in the region where the oil phase exists. Outside the oil plume the equilibrium approximation takes on a simpler form to partition constituent mass between the air, water, and adsorbed phases only. Microbial degradation of petroleum products is first discussed in a general model, then the conservation of mass equation for oxygen is incorporated into the analysis which takes advantage of the key role played by oxygen in the metabolism of hydrocarbon utilizing microbes in soil environments. Approximations to two subproblems, oil plume establishment in the unsaturated zone, and solute and vapor transport subsequent to immiscible plume establishment were developed from the general model. (See also W87-06830) (Author's abstract)
W87-06829

COMPOSITIONAL MULTIPHASE MODEL FOR GROUNDWATER CONTAMINATION BY PETROLEUM PRODUCTS: 2. NUMERICAL SOLUTION,
Geological Survey, Reston, VA. Water Resources Div.
A. L. Baehr, and M. Y. Corapcioglu.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 201-213, January 1987. 7 fig, 4 tab, 12 ref. NSF Grant CEE-8401438, ACS/ PRF 15890-AC5 and DOI G-897/02.

Descriptors: *Groundwater pollution, *Model studies, *Fate of pollutants, *Path of pollutants, *Petroleum products, *Hydrocarbons, Numerical solution, Solute transport, Transport, Biodegradation, Adsorption, Plumes, Gasoline, Underground storage, Prediction, Equations, Benzene, Toluene, Xylene.

A numerical solution to equations developed in part 1 to predict the fate of an immiscible organic contaminant such as gasoline in the unsaturated zone subsequent to plume establishment was developed. This solution, obtained by using a finite difference scheme and a method of forward projection to evaluate nonlinear coefficients, provides estimates of the flux of solubilized hydrocarbon constituents to groundwater from the portion of a spill which remains trapped in a soil after routine remedial efforts to recover the product have ceased. The procedure was used to solve the one-dimensional (vertical) form of the system of nonlinear partial differential equations defining the transport for each constituent of the product. Additionally, a homogeneous, isothermal soil with constant water content was assumed. An equilibrium assumption partitions the constituents between air,

water, adsorbed, and immiscible phases. Free oxygen transport in the soil was also simulated to provide an upper bound estimate of aerobic biodegradation rates. Rates at which hydrocarbon mass is removed from the soil, entering eithe r the atmosphere or groundwater, or is biodegraded are presented for a hypothetical gasoline consisting of eight groups of hydrocarbon constituents. A significant sensitivity to model parameters, particularly the parameters characterizing diffusive vapor transport, was discovered. It is concluded that hydrocarbon solute composition in groundwater beneath a gasoline contaminated soil would be heavily weighted toward aromatic constituents like benzene, toluene, and xylene. (See also W87-06829) (Author's abstract)
W87-06830

VERTICAL DIFFUSION IN A STRATIFIED COOLING LAKE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams, S. A. Wells, and E. K. Ho.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 293-307, March 1987. 6 fig, 2 tab, 19 ref.

Descriptors: *Cooling ponds, *Mixing, *Model studies, *Water temperature, *Cooling water, *Reservoirs, *Diffusion, *Lake Anna, *Flow rates, Prediction, Heated water, Lakes, Temperature, Heat flow, Condensers.

Lake Anna, a reservoir of 3,900 ha and 21 m maximum depth, provides cooling water for the two-unit North Anna Nuclear Power Station in Virginia. Using the flux-gradient method, vertical diffusivities in the lower layers of Lake Anna were computed from seven years of temperature data dating back to before plant operation. Results indicate strong dependence of vertical mixing on condenser flow rate with average summertime diffusivities below the surface layer ranging from 0.46-0.68 sq m/day for conditions of two-unit operation and from 0.06-0.14 sq m/day for conditions of zero to one unit operation. Parameters for vertical diffusion were developed as a calibrated function of condenser flow rate, wind speed, and a characteristic vertical density difference. A numerical model employing these parameters gave good agreement between measured and predicted vertical temperature profiles during separate validation tests. (Author's abstract)
W87-06833

INCLINED DENSE JETS IN FLOWING CURRENT,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
P. J. W. Roberts, and G. Toms.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 323-341, March 1987. 6 fig, 2 tab, 13 ref.

Descriptors: *Water currents, *Wastewater disposal, *Mixing, *Path of pollutants, *Hydrodynamics, *Jets, *Froude number, *Mathematical equations, Discharge, Dilution, Crossflow, Stagnant water.

An extensive series of experiments was conducted on the characteristics of inclined and vertical dense jets discharged into a uniform crossflow of various speeds and directions. The inclined jets were maintained at 60 deg to the horizontal and the results for terminal rise height, and dilutions at the terminal rise height and impact points were compared to those for vertical jets. For discharges into stagnant ambients, the effect of source volume flux should not be neglected for jet Froude numbers less than 25. Empirical equations to predict dilution and rise height based on dimensional and length scale arguments are presented. The dilution of an inclined jet increases as the angle to the current increases. Dilutions for inclined jets discharging into the crossflow are lower than for a vertical jet and dilutions for discharges with the crossflow are generally higher. Applications to design are discussed. The inclined jet is generally preferable to the vertical jet. This is because of the lower rise height of the inclined jet, the much higher dilution under stagnant conditions, and the horizontal momentum given to the wastefield. (Author's abstract)
W87-06835

INSTALLATION RESTORATION PROGRAM, PHASE I: RECORDS SEARCH REESE AFB, TEXAS.
Radian Corp., Austin, TX.
For primary bibliographic entry see Field 5E.
W87-06843

DESIGN IMPROVEMENTS ON SHALLOW-LAND BURIAL TRENCHES FOR DISPOSING OF LOW-LEVEL RADIOACTIVE WASTE,
Texas Univ., Austin.
For primary bibliographic entry see Field 5E.
W87-06845

ANALYTICAL CHEMISTRY OF PCBS,
Midwest Research Inst., Kansas City, MO.
For primary bibliographic entry see Field 5A.
W87-06848

GROUNDWATER CONTAMINATION AND RECLAMATION.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 2F.
W87-06850

STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM: GROUND WATER RESEARCH,
Geological Survey, Reston, VA. Office of Water Data Coordination.
J. S. Burton.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 13-17, 12 ref.

Descriptors: *Groundwater quality, *Path of pollutants, *Water pollution effects, *Groundwater pollution, Fate of pollutants, Septic tanks, Pesticides, Leachates, Nitrates, Coliforms, Organic compounds, Karst, Minnesota.

The State Water Resources Research Program in groundwater contamination research is reviewed to assess the progress made toward understanding the mechanisms of groundwater contamination and based on this understanding, to suggest procedures for the prevention and control of groundwater contamination. The following research areas are covered: (1) mechanisms of organic contaminant transport in the subsurface environment; (2) bacterial and viral contamination of groundwater from landfills and septic tank systems; (3) fate and persistence of pesticides in the subsurface; (4) leachability and transport of groundwater pollutants from coal production and utilization; and (5) pollution of groundwater from mineral mining activities. Discussed are the following chemical constituents in groundwater: nitrate-nitrogen, total coliforms, radioisotopes, barium, and the organic compounds, TCE, PCP, and 3-3'-dichlorobenzidine (DCB). Concentrations of nitrate-nitrogen and total coliform exceeding the EPA acceptable limits for drinking water were found in the Galena Formation in the karst area of southern Minnesota; data showed that the deeper aquifer in this formation was affected by surface runoff. Geochemical mechanisms were examined to explain the concentrations of 226-Ra, 228-Ra, and Ba(2+) in groundwater. Other research examined the degree to which TCE, PCP, and DCB adsorbed to soil and, as a result, the ability of each constituent to migrate through the soil to groundwater. Results suggested that TCE would migrate more readily through the soil than PCP. In terms of sources of pollution, groundwater contamination from waste treatment facilities can be minimized through proper siting, operation, and monitoring. In energy development, research showed that consideration should be given to the placement of overburden from surface-mining operations to prevent contamination of groundwater. (See W87-06850) (Lantz-PTT)
W87-06852

FENCE LAKE COAL PROJECT, GROUNDWATER MONITORING,
Dames and Moore, Phoenix, AZ.
G. G. Seifert, and M. A. Greenberg.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 19-25, 4 fig, 2 tab, 4 ref.

Descriptors: *Water quality control, *Groundwater quality, *Monitoring, *Fence Lake, *New Mexico, Aquifers, Bicarbonates, Test wells, Coal mines, Water pollution control, Industrial wastewater.

A baseline groundwater monitoring program was initiated at the Salt River Project's coal leasehold near Fence Lake in Catron County, New Mexico, in order to meet the mine permitting requirements of the state of New Mexico. Forty-seven monitoring wells were installed over an 18 sq mi area. The wells were completed in formations above and below the coal seam to be mined as well as the coal seam itself. Aquifer tests were performed to establish transmissivity and storativity values for the aquifers. Water quality sampling shows that the chemical character of groundwater in the area is predominantly sodium bicarbonate. Total dissolved solids concentrations range from 500 to 1200 mg/L. Knowledge gained through water quality sampling, aquifer testing, water level monitoring, and overburden toxicity studies will be used to predict the impacts of mining coal on groundwater quality in the area. (See also W87-06850) (Author's abstract)
W87-06853

RMA SOUTHERN TIER CONTAMINATION SURVEY,
Dames and Moore, Bethesda, MD.
R. C. Tucker, and S. Lemont.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 27-36, 5 fig, 3 tab, 1 ref.

Descriptors: *Rocky Mountain Arsenal, *Path of pollutants, *Fate of pollutants, *Groundwater pollution, *Denver, *Colorado, Environmental impact statement, Sludge, Sediment contamination, Hazardous wastes.

The City and County of Denver have advised the Federal Aviation Administration (FAA) that they would like to develop a new east-west runway for Stapleton International Airport to be located on the 'Southern Tier' of the Rocky Mountain Arsenal. The FAA is preparing an Environmental Impact Statement (EIS) for this proposed expansion. Though generally undeveloped and undisturbed, a number of areas were identified in the Southern Tier as known or potentially contaminated areas. There are three sites known to contain pesticide and mercury contamination. These are buried sludges dredged from nearby lakes and a pond where sediments were carried during a large storm. On other sites were located storage sheds for incendiary munitions. An environmental survey of the area was conducted to provide a concise explanation of the contamination condition present in these areas, for inclusion in the FAA's EIS. The survey involved aerial photo interpretation, soil borings and sampling, well installation, surface and groundwater sampling, sediment sampling, and laboratory analysis. Data analysis and contamination assessment focused on identification and quantification of volume and extent of known or suspected sources of contamination. The following conclusions were drawn with respect to conditions in the RMA Southern Tier: (1) no drinking water standards or guidelines were exceeded in any water samples collected, except for iron and manganese, which in almost all areas occur in naturally high concentrations; (2) other than in soil and sediment samples taken at three sites, no significant contamination was found in samples of groundwater, sur-

face water, sediment, and soils collected; (3) there is little potential for offsite migration of contamination from the RMA Southern Tier; and (4) based on the 'worst case' scenario analysis, contamination requiring remedial action was detectedat the same three sites. Remedial actions were identified where appropriate. (See also W87-06850) (Lantz-PTT)
W87-06854

REGIONAL GROUND-WATER-QUALITY NETWORK DESIGN,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W87-06855

GROUND WATER POLLUTION INVESTIGATION TECHNIQUES, TUCSON, ARIZONA: A REVIEW OF RECENT PROJECTS IN THE VICINITY OF THE TUCSON INTERNATIONAL AIRPORT,
Tucson Water Dept., AZ.
G. L. Hix.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 45-53, 5 fig, 17 ref.

Descriptors: *Groundwater pollution, *Sampling, *Monitoring, *Tucson, *Arizona, *Path of pollutants, *Trichloroethene, Groundwater quality, Geohydrology, Water analysis, Soil sampling, Monitoring.

Contamination of the groundwater by the organic solvent Trichloroethene (TCE) was first detected in the Tucson basin in 1981. A series of water samples taken from existing wells in the area of the Tucson International Airport indicated that the groundwater beneath the Hughes Aircraft Company facility was seriously contaminated. Later investigations revealed more contamination several miles to the north. The areas affected included: the Tucson International Airport, the Hughes Aircraft Company facility (a U.S. Air Force defense plant), an Air National Guard facility, a portion of the San Xavier Indian Reservation, several Tucson Water municipal supply wells, and numerous private water wells. Since 1981, hydrogeologic investigations have been conducted by the USAF and Hughes Aircraft Company, the Environmental Protection Agency (EPA), the Arizona Department of Health Services (ADHS), Tucson Water, and several University of Arizona graduate students. Each entity has investigated the contamination from a different perspective, with a different objective in mind, and in a slightly different manner. Four of the above, the USAF (Hughes), EPA, ADHS and Tucson Water, have conducted drilling, soil sampling, and groundwater monitor well construction programs. Each program involved a different drilling, soil sampling, and monitor well construction method. Consequently, the results of each investigation vary slightly and care must be taken when making geologic correlations from one program to another. This paper looks at these four hydrogeologic investigations; specifically at the drilling, soil sampling, and monitor well construction methods of each program and points out why the results are different. The techniques used by each and the lessons learned by all, may be of benefit to other investigators in similar environments. (See also W87-06850) (Author's abstract)
W87-06856

DECREASES IN HYDROCARBONS BY SOIL BACTERIA,
Arizona Univ., Tucson. Univ. Analytical Center.
L. D. Stetzenbach, L. M. Kelley, K. J. Stezenbach, and N. A. Sinclair.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 55-60, 6 fig, 2 tab, 13 ref.

Descriptors: *Hydrocarbons, *Biodegradation, *Soil bacteria, *Path of pollutants, *Fate of pollutants, Naphthalene, Fluorene, Anthracene, Pyrene, Chemical analysis, Microorganisms, Soil contamination, Groundwater pollution.

Degradation by 'Naturally occurring' microorganisms may significantly affect the persistance of pollutants in the environment. To assess the impact of microbial activity on the concentration of polyaromatic hydrocarbons (PAHs), randomly selected isolates from aseptically collected soil cores of petroleum contamination and uncontaminated background sites were incubated with naphthalene, fluorene, anthracene, and pyrene (4 PAHs present in the groundwater underlying the contaminant site). Significant decreases in the concentration of naphthalene was noted, using High Performance Liquid Chromatography with fluorescence detection, in cultures with isolates from the uncontaminated sites. Enumeration with acridine orange direct count and standard plate count demonstrated thatbacterial numbers increased proportionally with decreased PAH concentration. (See also W87-06850) (Author's abstract)
W87-06857

INTERAGENCY STUDY OF OILFIELD BRINE POLLUTION IN KANSAS,
Kansas State Geological Survey, Lawrence.
D. O. Whittemore, M. Sophocleous, W. R. Bryson, J. Schoof, and T. C. Bell.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 109-116, 3 fig, 8 ref.

Descriptors: *Oil fields, *Brine, *Kansas, *Path of pollutants, *Groundwater pollution, Industrial wastes, Aquifers, Water pollution sources, Waste disposal, Saline water, Groundwater movement.

An interagency task force has determined the source, extent, and movement of groundwaters polluted by oil field brine in the Equus Beds, south-central Kansas, and has given and is carrying out recommendations for protection of the aquifer. In addition to oil brine pollution, which originated mainly from disposal ponds during the 1930's to 1950's, natural salt waters occur in the bedrock underlying the unconsolidated aquifer. The current distribution of contaminated water was determined by sampling monitoring and water-supply wells. The oil brine source of most of the salt water pollution in the region was confirmed and delineated from the natural salt water contaminated by interpretation of mixing curves of bromide/chloride versus chloride concentrations. The history of oil field development and brine disposal was investigated to document the amounts and concentration of brine disposed and the various disposal practices used. An inventory of operating and abandoned (plugged) oil and gas wells (including enhanced recovery wells), disposal distribution lines and wells, and cement-lined pits currently used for temporary salt water storage was made to assess possible ongoing and future sources of contamination. The groundwater flow and contamination plume movement were modeled to determine the distribution of polluted groundwaters with time. This was done in order to assess the future water quality in locations where appropriations are requested and to evaluate the effect additional wells and increased pumping might have on the quality and movement of the plume. (See also W87-06850) (Author's abstract)
W87-06864

STRATIGRAPHIC INFLUENCE ON CLEAN-UP METHODS: A CASE HISTORY,
Dames and Moore, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W87-06867

IDENTIFICATION OF COMPONENTS IN AQUEOUS EFFLUENTS ASSOCIATED WITH NEW COAL TECHNOLOGIES AND GEOTHERMAL ENERGY SOURCES,
Gulf South Research Inst., New Orleans, LA. Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W87-06879

EVALUATION OF UTILITY WASTES FOR HAZARDOUS WASTE POTENTIAL,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-06880

ELEMENTAL COMPOSITION OF SIMULATED IN SITU OIL SHALE RETORT WATER,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06881

VALIDATION AND PREDICTABILITY OF LABORATORY METHODS FOR ASSESSING THE FATE AND EFFECTS OF CONTAMINANTS IN AQUATIC ECOSYSTEMS.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5C.
W87-06912

COMPARISON OF MICROBIAL TRANSFORMATION RATE COEFFICIENTS OF XENOBIOTIC CHEMICALS BETWEEN FIELD-COLLECTED AND LABORATORY MICROCOSM MICROBIOTA,
Environmental Research Lab., Athens, GA.
D. L. Lewis, R. B. Kellogg, and H. W. Holm.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 3-13, 3 fig, 2 tab, 5 ref.

Descriptors: *Biodegradation, *Microbiological studies, *Xenobiotic chemicals, *Microcosms, *Mathematical studies, *Fate of pollutants, Rate coefficients, Methyl parathion, Diethyl phthalate, Aquatic ecosystems, Pesticides, Organic compounds.

Two second-order transformation rate coefficients k sub b, based on total plate counts, and k sub A, based on periphyton-colonized surface areas - were used to compare xenobiotic chemical transformation by laboratory-developed (microcosm) and by field collected microbiota. Similarity of transformer to nontransformer community structure in blended aufwuchs was indicated by k sub b values, and similarity of transformation rates per unit of periphyton-colonized surface area was indicated by k sub A values. Xenobiotic chemicals used for the comparisons were methyl parathion (MP), diethyl phthalate (DEP), and 2,4-dichlorophenoxyacetic acid butoxyethyl ester (2,4-DBE). Even though rate coefficients of each of the chemicals were similar among microcosm- and field-collected microbial samples, not all of the field-collected samples showed MP or DEP transformation. The MP transformation was suppressed by aqueous extracts of field-collected, algae-dominated aufwuchs. Lack of DEP transformation appeared to have resulted from an absence of DEP-transforming bacteria in field-collected aufwuchs samples. (See also W87-06912) (Author's abstract)
W87-06913

COMPARISON OF ENVIRONMENTAL EFFECT AND BIOTRANSFORMATION OF TOXICANTS ON LABORATORY MICROCOSM AND FIELD MICROBIAL COMMUNITIES,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 5C.
W87-06914

USE OF A THREE-PHASE MICROCOSM FOR ANALYSIS OF CONTAMINANT STRESS ON AQUATIC ECOSYSTEMS,

Tennessee Technological Univ., Cookeville.
V. D. Adams, M. D. Werner, J. D. Parker, and D. B. Porcella.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 31-42, 7 fig, 1 tab, 35 ref.

Descriptors: *Aquatic microcosms, *Water pollution effects, *Fate of pollutants, *Microcosms, *Aquatic environment, *Lake Powell, *Bear Lake, Ecosystems, Benzanthracene, Hydrocarbons, Organic compounds, Lakes, Limnology.

Results of two studies concerning contamination from organic compounds in three-phase aquatic microcosm (TPAM) demonstrate the reliability, sensitivity, versatility, and high degree of control the TPAM research technique offers. Benz(a)anthracene (BA) had no detectable effect on the structure or function of an ecosystem simulating Lake Powell, UT/AZ. The fate of over 95% of the compound was known following the 60-day experiment. The majority of BA remained associated with sediments, as predicted based on other studies. In the second study, crude oil addition had a significant impact on microcosms representing Bear Lake, UT/ID, as shown by essentially every parameter measured. Results of the TPAM research were similar to published results of other research, and to related in situ research conducted concurrently. Aspects of the physical environment were apparently the most critical characteristics of the natural system not simulated in the TPAM. Specifically, reduced light intensity during the BA experiment led to some predictably different results than reported for environments in natural systems. (See also W87-06912) (Author's abstract)
W87-06915

MODELS FOR PREDICTING THE FATE OF SYNTHETIC CHEMICALS IN AQUATIC ECOSYSTEMS,
Environmental Research Lab., Athens, GA.
L. A. Burns.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, ND, Aug. 8, 1983. 1985. p 176-190, 11 fig, 33 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Ecosystems, *Aquatic environment, *Model studies, *Organic compounds, Synthetic chemicals, Mathematical models, Simulation analysis, Biotransformation, Prediction.

The toxic effects of synthetic chemicals released into natural environments are a function of concentrations, of physico-chemical speciations, and of transformation products whose genesis is mediated by properties of the environment itself. Accurate evaluation of the probable consequences of particular releases requires an ability to forecast the speciation, transport, and transformations of chemicals. In aquatic systems, ionic and sorptive equilibria, advective and dispersive fluid transport, benthic uptake and release processes, volatilization, hydrolysis, direct and indirect photochemical processes, redox reactions, and microbial transformations have significant effects on the fate of introduced chemicals. Recent and continuing investigations of the kinetics and environmental determinants of these processes have made possible the design of models and computer codes that can generate theoretically sound forecasts of chemical events in ecosystems. These 'fate codes', when coupled to equally rigorous techniques for computing effects of chemicals, can enhance the rationality, realism, and reliability of chemical safety evaluations. (See also W87-06912) (Author's abstract)
W87-06924

CONCEPT OF PROGNOSTIC MODEL ASSESSMENT OF TOXIC CHEMICAL FATE,
Oregon State Univ., Corvallis. Dept. of Statistics.
W. S. Overton, and R. R. Lassiter.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, ND, Aug. 8, 1983. 1985. 1985. p 191-203, 15 ref.

Descriptors: *Organic compounds, *Toxicity, *Model testing, *Fate of pollutants, *Toxicity, *Water pollutant effects, *Prognostic models, *Model studies, Environmental effects, Simulation analysis, Prediction, Field tests, Calibratious.

Prognostic assessment is an activity directed toward discovering, for a chemical with little or no experiential use, the probable pattern of behavior of that chemical if it were introduced into the environment. A prognostic assessment protocol should be thought of as a heuristic tool for aiding the discovery process. Successful use of the methodology requires credible components, the most concrete of which, exposure assessment models, have been subjected to limited tests for the purpose of establishing this credibility. It is emphasized that the design criteria for the models require a highly hypothetic structure, so that field testing is ordinarily inappropriate. Such hypothetic models must be examined in a protocol that has a high probability of discovering those environmental circumstances in which a chemical is likely to exhibit critical behavior, and the assessment results must be heuristically interpreted, in order that the limitations of the model/protocol structures are adequately taken into account. Even though the model structures are not subject to field validation, they are subject to theoretical verification and to experimental validation. Experiments designed expressly for the purpose of estimating parameters in the models will provide an additional level of validity. Validation of the process, of the heuristic prognostic assessment through a protocol/model pair, is not only feasible, but an essential ongoing aspect of assessment. Both field studies and retrospective studies appear potentially productive at this level of validation. (See also W87-06912) (Lantz-PTT)
W87-06925

ASSESSMENT OF TRACE GROUND WATER CONTAMINANTS RELEASE FROM SOUTH TEXAS IN-SITU URANIUM SOLUTION MINING SITES,
Texas Univ. at Austin. Dept. of Civil Engineering.
J. R. Kidwell, and M. J. Humenick.
CRWR Paper 179, January 1981. Technical Report. 111 p, 22 ref, 6 tab, 92 ref, 2 append.

Descriptors: *Radioactive wastes, *Groundwater pollution, *Path of pollutants, *Texas, *Uranium, *Mine wastes, *Groundwater quality, Water quality control, Solubility, Molybdenum, Arsenic, Vanadium, Selenium, Drinking water, Heavy metals.

The future of uranium solution mining in South Texas depends heavily on the industry's ability to restore production zone groundwater to acceptable standards. This study investigated the extent of trace contaminant solubilization during mining and subsequent restoration attempts, first through a literature search centered on uranium control mechanisms, and then by laboratory experiments simulating the mining process. The literature search indicated the complexity of the situation. The number of possible interactions between indigenous elements and materials pointed to the site specificity of the problem. The column studies evaluated three different production area ores. Uranium, molybdenum, arsenic, vanadium, and selenium were analyzed in column effluents. After simulated mining operations were completed, uranium was found to be the most persistent trace element. However, subsequent groundwater flushing of the columns could restore in-situ water to EPA recommended drinking water concentrations. Limited data indicated that groundwater flowing through mined areas may solubilize molybdenum present in downgradient areas adjacent to the production zone due to increased oxidation potential of groundwater if adequate restoration procedures are not followed. (Author's abstract)
W87-06940

STREAMLINE-CONCENTRATION BALANCE MODEL FOR IN-SITU URANIUM LEACHING AND SITE RESTORATION,
Texas Univ. at Austin. Center for Research in Water Resources.
P. M. Bommer, R. S. Schechter, and M. J. Humenick.
CRWR Report No. 180, March 1981. Technical Report. 260 p, 45 fig, 20 ref.

Descriptors: *Waste disposal, *Water pollution treatment, *Path of pollutants, *Computer models, *Uranium, *Leaching, *Model studies, *Cleanup operations, Data interpretation, Cations, Ion exchange, Mathematical studies.

Computer models describe in-situ uranium leaching and post-leaching site restoration. Both models use a streamline generator to set up the flow field over the reservoir. The leaching model then uses the flow data in a concentration balance along each streamline coupled with the appropriate reaction kinetics to calculate uranium production. The restoration model uses the same procedure except that binary cation exchange is used as the restoring mechanisms along each streamline and leaching cation cleanup is simulated. The mathematical basis for each model is shown in detail along with the computational schemes used. Finally, the two models were used with several data sets to point out their capabilities and to illustrate important leaching and restoration parameters and schemes. (Author's abstract)
W87-06944

LEACHING EXPERIMENTS ON COAL PREPARATION WASTES: COMPARISONS OF THE EPA EXTRACTION PROCEDURE WITH OTHER METHODS,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5E.
W87-06945

ROLE OF THE UNSATURATED ZONE IN RADIOACTIVE AND HAZARDOUS WASTE DISPOSAL.
For primary bibliographic entry see Field 5E.
W87-06947

NRC-FUNDED STUDIES ON WASTE DISPOSAL IN PARTIALLY SATURATED MEDIA,
Nuclear Regulatory Commission, Washington, DC. Low-Level Waste Licensing Branch.
For primary bibliographic entry see Field 5E.
W87-06948

MODELING OF MOISTURE MOVEMENT THROUGH LAYERED TRENCH COVERS,
Illinois State Geological Survey Div., Champaign.
T. M. Johnson, K. Cartwright, B. L. Herzog, and T. H. Larson.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 11-26, 16 fig, 14 ref. NRC Contract NRC 02-80-074.

Descriptors: *Hazardous wastes, *Model studies, *Path of pollutants, *Trench covers, *Permeability coefficient, *Flow profiles, *Waste disposal, Radioactive wastes, Infiltration, Computer models, Simulation analysis, Hydraulic conductivity.

Low-level radioactive wastes in the United States are currently buried in trenches in 11 major shallow land-burial grounds. Six of these sites - two federal and four commercial - are located in the relatively wet eastern part of the country. Tritium migration has been observed at five of these sites, and is thought to be caused by infiltration of precipitation through trench covers. Trench covers at all 11 sites consist of material excavated from the trenches. The material is typically mounded toa depth of 1-3 m and planted with grass. At sites in

relatively wet regions, covers are compacted by earthmoving equipment, or material excavated from an adjacent trench is temporarily placed on the cover. At some sites, infiltration through trench covers has resulted in accumulation of water within the waste; at other sites, infiltration has caused migration of contaminants, although no free water has been observed in the trench. The results of laboratory experiments and computer simulations of several preliminary cover designs indicate that a layer of coarse-textured, unsaturated material overlain by fine-grained material serves as a barrier to moisture movement. The effectiveness of the barrier is related to the contrast in saturated hydraulic conductivity and texture between the two layers. These investigations also indicate that prior to breakthrough, moisture in the fine-grained layer overlying a coarse-textured layer in a sloping cover flows laterally downslope above the interface. It has been suggested previously that saturation of the overlying layer is required before moisture breakthrough will occur in such layered systems. However, these results indicate that moisture movement through layered systems of highly contrasting texture can occur when the moisture content of the overlying layer is less than saturation and the pressure head at the interface is less than zero. The significance of these results must be evaluated in terms of observed behavior in laboratory columns, field experiments, and present capability of instrument measurement of the parameters of interest. (See also W87-06947) (Lantz-PTT)
W87-06949

MODEL TO SIMULATE INFILTRATION OF RAINWATER THROUGH THE COVER OF A RADIOACTIVE WASTE TRENCH UNDER SATURATED AND UNSATURATED CONDITIONS,
Office of Radiation Programs, Washington, DC.
C. Y. Hung.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 27-48, 6 fig, 1 tab, 25 ref.

Descriptors: *Hazardous wastes, *Path of pollutants, *Infiltration, *Radioactive wastes, *Saturated soils, *Model studies, *Mathematical models, *Waste disposal, Soil water, Gravity flow, Municipal wastes, Chemical wastes, Hydraulic conductivity.

Presented is a mathematical model which simulates the infiltration of rainwater through a homogeneous earth cover over radioactive, chemical, or municipal waste disposal trenches under saturated and unsaturated conditions. The infiltration model includes overland flow, subsurface flow, and atmospheric diffusion systems. Space dependent variables of the basic differential equations which govern the movement of water or vapor through these three systems were transformed into space independent variables by introducing some engineering assumptions. Emphasized here is the transformation of the subsurface flow system. Transformation of the subsurface flow system involves the concept of dividing soil moisture into three components: gravity, pellicular, and hygroscopic waters. The proposed model was tested against the studies conducted by other investigators by applying the model to the Barnwell radioactive waste disposal site. The results indicated close agreement between the results obtained from the proposed model and those obtained from other investigators. (See also W87-06947) (Author's abstract)
W87-06950

SIMULATION OF THE EFFECTS OF ORGANIC SOLUTES ON THE HYDRAULIC CONDUCTIVITY OF VARIABLY SATURATED, LAYERED MEDIA,
Ertec Western, Inc., Long Beach, CA.
E. G. Lappala.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 49-69, 7 fig, 3 tab, 9 ref.

Descriptors: *Model studies, *Simulation analysis, *Organic compounds, *Permeability coefficients, *Saturated media, *Clays, *Path of pollutants, Aquifers, Mathematical studies, Saturated flow, Hydraulic conductivity.

The most common method of attempting to prevent contamination of aquifers by leachate from landfills and disposal ponds is compacted clay layers. Compacted clays are used because they are often locally available and economically attractive. In addition, compaction methods used can often achieve saturated hydraulic conductivities as low as 1 times 10 to the -9th power cm/sec. Although all clay liners will eventually allow the passage of liquid wastes, conductivities of this magnitude are usually sufficient to contain liquids for periods of tens of years. Such containment, however, requires that the integrity of the clay liner is not compromised by physical, chemical, biological, or human actions. Methodologies for simulating the effects of clay dissolution were incorporated into an existing code. The major modification involved adding a method for computing the position of the solvent front and recalculation of the intrinsic conductivity after each time-step. The results of this investigation can be summarized as follows: (1) results agree with established concepts of variably saturated flow. Establishment of steady, unsaturated flow beneath the fine-grained layers, perching and rapid movement of wetting fronts through coarse materials occurred for both water and the solvent; (2) increased computational effort was required by the inclusion of an exponential increase in intrinsic permeability as a function of solvent pore volumes. The increased effort, as measured by the number of iterations required to achieve a given simulation time, ranged from 30-50%. As lab and field tests are completed, a compilation of the data should provide a database to establish the functions describing permeability changes. These functions can and should be incorporated into models that are used to design and evaluate disposal systems which involve clays subject to dissolution. Use of this feature will cause additional computational difficulty, but should prove to be tractable by resorting a sufficient number of numerical devices used to linearizing the flow equation and to limiting the maximum allowed saturation change during timesteps. (See also W870-06947) (Lantz-PTT)
W87-06951

ROLE OF PARTIALLY SATURATED SOIL IN LINER DESIGN FOR HAZARDOUS WASTE DISPOSAL SITES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5E.
W87-06953

ROLE OF DESATURATION ON TRANSPORT THROUGH FRACTURED ROCK,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
D. D. Evans, and C.-H. Huang.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 165-178, 10 fig, 2 tab, 10 ref.

Descriptors: *Desaturation, *Hazardous wastes, *Path of pollutants, *Solute transport, *Geologic fractures, *Soil water, Radioactive wastes, Groundwater movement, Waste disposal, Granite, Basalt, Tuff, Salt, Saturated soils, Leakage, Aeration zone.

The safe, long-term storage of high level radioactive wastes is a critical issue facing governments of different levels, and private enterprises. The production of such wastes is increasing rapidly, necessitating an early solution to the waste disposal problem. The most promising solution at present is the construction of repositories at several hundred meters below surface within a geological formation where the wastes will be isolated from the biosphere until the radioactivity decays to an acceptable level. Geologic formations of most interest are those of igneous rocks, such as granite, basalt and tuff, and salt. In characterizing a potential repository site, it is necessary to account for the rare chance of leakage of contaminants and their entering the regional hydrologic system and being transported to other locations. Therefore, predictions of water movement over long time spans is crucial during the site selection and licensing processes. The potential repository zone may be initially water saturated or unsaturated. Even if the zone is initially saturated, unsaturated conditions may develop during repository construction and operation by artificial dewatering, or at some later time due to climatic change or regional water management modifications. This presentation deals with flow through unsaturated igneous rock systems. Since rock formations are invariably fractured to some degree, the fractures may be the principal conduits for water flow and contaminant transport. Hence, the focus is on the fracture system, rather than the rock matrix per se. (See also W87-06947) (Lantz-PTT)
W87-06958

HYDROGEOLOGICAL INVESTIGATION HAZARDOUS WASTE SITE, ATLANTIC CITY, NEW JERSEY,
International Exploration, Inc., Warminister, PA.
D. Pennington.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 211-227, 2 fig, 4 tab.

Descriptors: *Path of pollutants, *Geohydrology, *Waste disposal, *Atlantic City, *New Jersey, *Hazardous wastes, *Leachates, *Aquifers.Water supply, Resistivity, Schlumberger array, Plumes, Observation wells.

Hydrogeological studies of an abandoned hazardous waste site, alleged to threaten the water supply of Atlantic City, New Jersey, were utilized to identify a leachate plume. Also, several additional sources of pollution in the vicinity of the hazardous waste site were found. Resistivity surveys, a stream sediment survey and soil investigations which included soil profiles, were part of the site investigation. Resistivity measurements, utilizing the Schlumberger array, identified a leachate plume originating from thedisposal site. Observation wells and boreholes were drilled for geological control and correlation of the resistivity data. An unknown clay layer also was identified which separated two aquifers and acted as a barrier to downward movement of leachate. (See also W87-06947) (Author's abstract)
W87-06961

HYDROLOGIC STUDY OF THE UNSATURATED ZONE ADJACENT TO A RADIOACTIVE WASTE DISPOSAL SITE AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
Environmental Resources Management, Inc., West Chester, PA.
For primary bibliographic entry see Field 2G.
W87-06963

PRECISION BATHYMETRIC STUDY OF DREDGED-MATERIAL CAPPING EXPERIMENT IN LONG ISLAND SOUND,
Science Applications, Inc., Newport, RI. Ocean Science and Technology Div.
R. W. Morton.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 99-121, 11 fig, 1 tab, 1 ref.

Descriptors: *Sediments, *Path of pollutants, *Waste disposal, *Water quality control, *Long Island Sound, *Dredging, *Bathymetry, Ocean dumping, Sediment transport, Monitoring, Silt, Sand, Topography.

Dredged-material disposal procedures were employed recently at the Central Long Island Sound Disposal Site to cap heavy-metal enriched material from Stamford, Connecticut with silt and sands from inner and outer New Haven Harbor. Monitoring of the disposal operation consisted of precision bathymetric mapping, visual observations of the sediment surface and margins, chemical comparisons of the dredged material and natural sedi-

ment, and sampling of benthic populations for recolonization and bioaccumulation studies. Prior to the dredging operation, two disposal sites for Stamford sediment were designated, one to be capped with sand, the other with silt. A survey grid for each site (25-m lane spacing) was programmed into a computerized navigation and bathymetric data acquisition system. Volume difference calculations between replicate surveys were made with errors less than + or - 1000 cu m. Profiles across both dredged-material mounds indicate that the Stamford sediment was concentrated in a low mound with rough topography and that both silt and sand provided adequate cover for the enriched material. Postdisposal monitoring over a six-month period revealed no significant changes in the sand cap. After two months, the silt cap had settled approximately 30 cm and slumping had occurred along the steep flanks. Six months after disposal, the silt cap was substantially altered with extensive slumping of the flanks, flattening of the top of the mound, and loss of material from the disposal site. However, the silt continued to provide adequate cover (2 m) for the Stamford material. The sand cap was more successful in terms of coverage and stability. The cohesive nature of the silt material resultedin a dredged-material mound that was thicker and steeper than expected. (See also W87-06979) (Author's abstract)
W87-06984

GEOCHEMICAL STUDY OF THE DREDGED-MATERIAL DEPOSIT IN THE NEW YORK BIGHT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5E.
W87-06985

OCEAN DUMPING OF DREDGED MATERIAL IN THE NEW YORK BIGHT: ORGANIC CHEMISTRY STUDIES,
Energy Resources Co., Inc., Cambridge, MA.
P. D. Boehm, and D. L. Fiest.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 151-169, 7 fig, 3 tab, 16 ref. NOAA-MESA New York Bight Program Contract NA-79-RAA-03401.

Descriptors: *Sediments, *Ocean disposal, *Dredging, *New York Bight, *Chemical analysis, *Path of pollutants, Water quality control, Aromatic compounds, Hydrocarbons, Polychlorinated biphenyls, Plumes.

Concentrations of polynuclear aromatic hydrocarbon (PAH) and polychlorinated biphenyl (PCB) were determined in a suite of samples from the waters of New York Bight prior to, during, and after a dredged-material disposal operation. The PAH profiles were compared with those of the source dredged material to evaluate short-term fractionation and weathering. Hydrocarbons associated with dredged material are rapidly altered in the water column by dissolution and microbial processes. The PAH and PCB measurements proved to be sensitive indicators of the movement and fate of dredged-material particulate plumes; 15 min after the dump the residual plume was found in near-bottom water and remained detectable for at least 2.5 h. (See also W87-06979) (Author's abstract)
W87-06986

SEDIMENT-COPPER RESERVOIR FORMATION BY THE BURROWING POLYCHAETE NEPHTYS INCISA,
Environmental Research Lab., Narragansett, RI.
W. R. Davis.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 173-184, 8 fig, 1 tab, 11 ref.

Descriptors: *Burrows, *Accumulation, *Sediments, *Copper, *Polychaetes, *Nephtys incisa, *Path of pollutants, Water pollution effects, Marine environment, Bioaccumulation, Ecosystems, Biodegradation, Heavy metals.

The activities of benthic infauna may be a major mechanism for exchange of contaminants between seawater and fine-grained sediments. For example, enhanced sediment uptake of copper can result from the burrowing and irrigation activities of the deposit-feeding polychaete, Nephtys incisa. The burrow walls provide additional surface for sorption of waterborne copper similar to that occurring at the sediment surface. Both of these surfaces concentrate copper to depths not exceeding 4 mm, suggesting a simple diffusion process. The burrow wall uptake of copper is of greater importance than surface sediment exchange for two reasons. First, the burrow penetrates the sediment to a depth of between 5 and 20 cm, depending on worm size; this may result in an approximately 10-40 times increase in potential copper uptake by the sediment. Secondly, N. incisa periodically extends it U-shaped burrow, leading to formation of a new burrow. This new burrow enhances sediment uptake of copper by exposing clean sediment to burrow irrigation water. Major variables affecting this biologically mediated uptake of copper include: abundance of N. incisa; worm size, which influences burrow depth and length; organic uptake; and the presence of particulate material in the overlying seawater, which acts to scavenge copper from the water. N. incisa burrow irrigation transports these suspended particles, with their sorbed copper, into the burrow for accumulation in the benthos. (See also W87-06979) (Author's abstract)
W87-06987

FACTORS AFFECTING UPTAKE OF CADMIUM AND OTHER TRACE METALS FROM MARINE SEDIMENTS BY SOME BOTTOM-DWELLING MARINE INVERTEBRATES,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, and D. W. McLeese.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 185-197, 5 fig, 8 tab, 18 ref.

Descriptors: *Cadmium, *Heavy metals, *Marine sediments, *Invertebrates, *Path of pollutants, *Water pollution effects, Bioaccumulation, Zinc, Copper, Lead, Fate of pollutants, Tissue analysis, Sediments, Population exposure.

A natural bioassay was conducted to determine the relationship, if any, between tissue contents of Cu, Zn, Cd, and Pb in bottom-dwelling marine invertebrates (crustaceans, polychaetes, and bivalves) and metal contents of the sediments. Bioaccumulation of these metals in the animals was low under natural circumstances. Metal contents of tissues remained fairly constant regardless of the metal contents of the sediments except for Macoma, a deposit-feeding bivalve. In laboratory studies, invertebrates were exposed to two naturally contaminated sediments for 30 days to simulate field conditions. Only Macoma showed increases in all four metals from one sediment, and in Cu and Pb from the other. The polychaete Nereis and the crustacean Crangon showed regulation of Cu and Zn from both sediments. Nereis showed increase in Cd and Pb contents of the animals exposed to only one of the two sediments, whereas Crangon showed increase in only Pb content of the animals exposed to both sediments. The bottom-dwelling polychaete Nereis virens, when exposed to Cd-spiked sediment in the laboratory, showed a linear increase of Cd in the animal tissue with time. Smaller worms accumulated higher amounts of Cd (per unit weight) than bigger ones. Cd excretion was not observed during the depuration phase. The Cd concentration within Nereis was related to the Cd concentration in the sediment, which in turn was related to the concentration of the element leached into the water. A study of the adsorption-desorption process of Cd in sediment-seawater systems indicated that the process is controlled by cation exchange capacity and organic carbon content of the sediments. (See also W87-06979) (Author's abstract)
W87-06988

CHANGES IN THE LEVELS OF PCBS IN MYTILUS EDULIS ASSOCIATED WITH DREDGED-MATERIAL DISPOSAL,
Connecticut Univ., Groton. Marine Sciences Inst.
R. Arimoto, and S. Y. Feng.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 199-212, 3 fig, 3 tab, 26 ref. U.S. Navy Contract 00140-77-6536.

Descriptors: *Bioaccumulation, *Bioindicators, *Sediments, *Path of pollutants, *Water pollution effects, *Polychlorinated biphenyls, *Mussels, *Dredging, *Waste disposal, *New London, *Connecticut, *Ocean disposal, Marine environment, Fate of pollutants, Chemical analysis, Statistical analysis, Population exposure.

Experimental populations of mussels (Mytilus edulis) were deployed on or near the New London, Connecticut, Dumpsite and used as indicators of polychlorinated biphenyl (PCB) concentrations during and after the disposal of dredged material. During the duping operations, the mean PCB concentrations of the dumpsite populations ranged from 520 to 800 nanograms/gm dry weight whereas those of reference populations from outside the disposal area ranged from 700 to 720 nanograms/gm. After dumping ceased, the mean PCB concentrations of the dumpsite mussels decreased (range = 510-590 nanograms/gm) as did those of the reference animals (range = 480-510 nanograms/gm). The difference between the mean PCB concentrations for the two sampling periods was significant at $p = .07$, but two lines of evidence indicated that dumping has, at most, a minor influence on PCB uptake. First, the mean PCB concentrations of the dumpsite populations were not higher than those of the reference populations either during or after dumping. Second, regression analyses showed that even though the PCB concentrations of the dumpsite animals were related to the volume of material dumped, the levels also were related to the rate of discharge from a nearby river. Furthermore, the multiple regression functions could account for no more than 40% of the observed variance in PCB concentrations, and most of the variance apparently was caused by factors which were not included in the regression functions. (See also W87-06979) (Author's abstract)
W87-06989

ESTIMATION OF THE POTENTIAL AND PROBABLE SOURCE REGIONS FOR ACID PRECIPITATION,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. J. Samson, M. E. Fernau, M. S. Halpert, J. D. Kahl, and G. J. Keeler.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE-84015119, Price codes: A05 in paper copy, and A01 in microfiche. Report No. DOE/ER/60058-1, July 1984. Final Report. 88 p, 44 fig, 9 tab, 41 ref. Agreement No. DOE-AC02-82ER60058.

Descriptors: *Acid rain, *Water pollution sources, *Sulfates, *Nitrates, *Path of pollutants, Sulfur dioxide, Nitrogen oxides, Mathematical studies, Air pollution sources, Model studies, Emission, Rainfall.

Concentrations of ionic species collected in the Multistate Atmospheric Power Production Study (MAP3S) were diagnosed to ascertain whether a relationship exists between the concentrations of sulfate and nitrate in precipitation and the magnitude of estimated upwind emissions of sulfur dioxide and nitrogen oxides, respectively. It was found that, even when segregated by season, the data fail to exhibit any well-defined relationship between emissions and resultant concentrations. Additionally, no significant correlation could be discerned between sulfate concentrations in precipitation and the inverse of estimated upwind wind speed. A regional-scale sulfur transport and deposition model was employed to estimate source-receptor relationships for sulfur compounds at each of the MAP3S receptors for each of three years, 1979 to

1981. These calculations illustrate that the range of variation in many specific source-receptor relationships may be as large as the absolute value of the source-receptor relationship itself. (Author's abstract)
W87-06994

CARBON-14 IN SLUDGE,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5E.
W87-06995

WATER BUDGET FOR SRP BURIAL GROUND AREA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
J. E. Hubbard, and R. H. Emslie.
Available from the National Technical Information Service, Springfield, Virginia. 22161 as DE84-015772, Price codes: A02 in paper copy, A01 in microfiche. Report No. DPST--83-742, March 19, 1984. 23 p, 10 fig, 5 tab, 13 ref.

Descriptors: *Hydrologic budget, *Isotope studies, *Waste disposal, *Savannah River Plant, *Groundwater pollution, *Path of pollutants, *Tritium, *Radioactive wastes, *Groundwater recharge, Percolation, Leaching, Flow patterns, Groundwater movement.

Radionuclide migration from the Savannah River Plant (SRP) burial ground for solid low-level waste was studied extensively. Most of the buried radionuclides are fixed on the soil and show negligible movement. The major exception is tritium, which when leached from the waste by percolating rainfall, forms tritiated water and moves with the groundwater. The presence of tritium was useful in tracing groundwater flow paths to outcrop. A subsurface tritium plume moving from the southwest corner of the burial ground toward an outcrop near Four Mile Creek was defined. Groundwater movement is so slow that much of the tritium decays before reaching the outcrop. As a first step in seeking deeper flow paths, a water budget was constructed for the burial ground site. The water budget, a materials balance used by hydrologists, is expressed in annual area inches of rainfall. Thus, the total inches of annual rainfall are separated into various consequences of the water, which include evapotranspiration, runoff, and groundwater recharge. Components of the water budget for the burial ground area were analyzed to determine whether significant flow paths may exist below the 'tan clay'. Mean annual precipitation was estimated as 47 inches, with evapotranspiration, runoff, and groundwater recharge estimated as 30, 2, and 15 inches, respectively. These estimates, when combined with groundwater discharge data, suggest that 5 inches of the groundwater recharge flow above the 'tan clay' and that 10 inches flow below the 'tan clay'. Therefore, two-thirds of the groundwater recharge appears to follow flow paths that are deeper than those previously found. (Lantz-PTT)
W87-06996

STATISTICAL METHODOLOGY FOR PREDICTING SALINITY IN UPPER LAVACA BAY,
Texas Univ. at Austin. Dept. of Civil Engineering.
S. H. Yamada, and N. E. Armstrong.
Technical Report No. CRWR-191, June 1982. 122 p, 27 fig, 13 tab, 38 ref, append.

Descriptors: *Statistical methods, *Salinity, *Lavaca Bay, *Texas, *Mathematical equations, *Model studies, *Saline water, *Regression analysis, Mathematical equations.

This study investigated the feasibility of developing salinity/freshwater inflow regression equations for Upper Lavaca Bay in Texas. First, previously derived regression models for the same area were evaluated and then a new equation form was developed and tested. The model evaluations pointed out the fact that no previous regression equations were designed to account for the variation of salinity across Upper Lavaca Bay. Since this capability was important for an environmental impact assessment model of Upper Lavaca Bay, a set of regression equations were derived for salinity sampling sites throughout the bay. In deriving the new equations, it was generally found that a 30-day antecendent flow period had the best correlation with the exception of the sites fronting the river months. The test results revealed that the proposed equations were able to model the fluctuations in salinity adequately. (Lantz-PTT)
W87-07002

SIMPLIFIED, STEADY-STATE TEMPERATURE AND DISSOLVED OXYGEN MODEL: USER'S GUIDE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2E.
W87-07007

NEAR-SURFACE GROUNDWATER RESPONSES TO INJECTION OF GEOTHERMAL WASTES,
Idaho Water and Energy Resources Research Inst., Moscow.
For primary bibliographic entry see Field 5E.
W87-07011

GROUNDWATER MODEL PARAMETER ESTIMATION USING A STOCHASTIC-CONVECTIVE APPROACH,
Battelle Pacific Northwest Labs., Richland, WA.
J. L. Devary, and C. S. Simmons.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84016275. Price codes: A04-PC in papercopy, A01-MF in microfiche. Electric Power Research Institute Report EPRI-CS--3629, July 1984. 52 p, 18 fig, 2 tab, 5 ref, append. Research Project 1406-1.

Descriptors: *Tracers, *Path of pollutants, *Groundwater quality, *Solute transport, *Model studies, *Stochastic hydrology, *Convection, *Groundwater movement, Mathematical models, Water quality control, Mathematical studies, Chlorides, Solutes.

Tracer tests data from the Borden Site in Canada were analyzed, to estimate the dispersion parameters necessary to implement dispersive transport models. An analysis of the chloride tracer data revealed that the dispersion coefficients increased significantly in the first 5 meters from the source. Beyond 5 meters, a constant, asymptotic dispersion coefficient is obtained. Also, in the 0 to 5 meter range, a lognormal distribution for fluid particle displacement in the longitudinal direction fits the tracer data significantly better than the Gaussian distribution does. Beyond 5 meters, the Gaussian distribution applies, suggesting traditional convective-dispersive transport. This suggests that the transport is progressing from an asymmetric, scale-dependent dispersive mechanism to a symmetric Gaussian-distributed plume as time progresses. The stochastic-convective transport approach effectively predicts the scale-dependent and asymmetric plume behavior by using the stochastic pore velocity field. The techniques for estimating spatial covariance functions of the stochastic pore velocity field, are discussed. (Author's abstract)
W87-07015

LABORATORY STUDIES ON THE HYDROCARBON GAS TRACER TECHNIQUE FOR REAERATION MEASUREMENT,
Texas Univ. at Austin. Center for Research in Water Resources.
K. A. Rainwater, and E. R. Holley.
Technical Report No. CRWR-189, December 1983. 114 p, 20 fig, 22 tab, 57 ref.

Descriptors: *Reaeration, *Tracers, *Hydrocarbon gases, Mathematical studies, Ethylene, Propane, Adsorption, Cation exchange, Hydrogen ion concentration, Organic carbon, Particle size.

The purpose of this project was to study two of the major assumptions of the hydrocarbon gas tracer technique for measurement of reaeration rates. The first assumption states that the ratios of the reaeration rate coefficient to the desorption rate coefficients of ethylene and propane, R sub E and R sub P, respectively, are constant and independent of temperature and mixing intensity. Mixing tests were done in an open stirred mixing tank at 4 C, 20 C, and 32 C to provide an independent comparison with previous results and to extend the temperature range. Mean values of the ratios were found to be 1.4 for R sub E and 1.36 for R sub P. These values compared well to the values of 1.15 and 1.39 reported by previous experimental studies. The second assumption which was studied states that losses of dissolved ethylene and propane due to adsorption on suspended sediment and organic material are negligible. Batch equilibrium adsorption studies were done utilizing five soils with varying soil characteristics of cation exchange capacity, pH, organic carbon content, and grain size distribution. Solutions of ethylene and propane in water were allowed to equilibrate with soil concentrations of 100 gm/L for a period of at least 24 hours. The results of the tests showed that the adsorptive losses of ethylene and propane were negligible within the accuracy of the hydrocarbon measurement techniques. (Author's abstract)
W87-07022

POLYCHLORINATED BIPHENYL TRANSPORT IN COASTAL MARINE FOODWEBS,
New York Univ. Medical Center, Tuxedo Park. Inst. of Environmental Medicine.
J. M. O'Connor.
Available from the National Technical Information Service, Springfield, VA, 22161, as PB84-232610, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/3-84-083, Aug. 1984. 98 p, 12 fig, 10 tab, 120 ref. EPA Contract CR808006.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Model studies, *Food chains, Coastal waters, Aroclor, Bass, Tissue analysis, Mathematical models, Diets, Organic compounds.

The extent to which polychlorinated biphenyls (PCBs) may be assimilated into fish from dietary sources was studied by providing known doses of PCBs (as Aroclor 1254 in food) to striped bass and analyzing cross-gut transport, tissue distribution and elimination. Assimilation and elimination data from single and multiple doses for whole fish were used to calculate rate-constants for PCB accumulation (k sub a) and elimination (k sub e) according to one-compartment pharmacokinetic models. The data from analysis of individual tissues were used to calculate k sub a and k sub e for individual tissue compartments. The major conclusions from the study are that PCBs in food represent a major source of PCB to fish (up to 80% of total body burdens). The PCBs obtained from food cause a rapid approach to steady state, but are eliminated slowly with a half-time of approximately 120 hours. More than 85% of the PCB ingested with food is assimilated into the tissues. The long-term model showed that PCB burdens in striped bass exposed to food containing different concentrations of PCB will decline slowly when levels in food decline, but increase rapidly (90% plateau reached in 9 doses) when levels in food increase. Preliminary verification studies support the pharmacokinetic model for PCB accumulation in striped bass with food as the major source. (Author's abstract)
W87-07023

EVALUATION OF WATERBORNE RADON IMPACT ON INDOOR AIR QUALITY AND ASSESSMENT OF CONTROL OPTIONS,
Envirodyne Engineers, Inc., St. Louis, MO.
For primary bibliographic entry see Field 5C.
W87-07024

DEVELOPMENT OF A MODIFIED ELUTRIATE TEST FOR ESTIMATING THE QUALITY OF EFFLUENT FROM CONFINED DREDGED MATERIAL DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.

W87-07028

INTERPRETATION OF THE CONVERGENT-FLOW TRACER TESTS CONDUCTED IN THE CULEBRA DOLOMITE AT THE H-3 AND H-4 HYDROPADS AT THE WASTE ISOLATION PILOT PLANT (WIPP) SITE,
INTERA Technologies, Inc., Austin, TX.
V. A. Kelley, and J. F. Pickens.
Available from the National Technical Information SErvice, Springfield, VA 22161as DE87-005212. All-PC in papercopy, A01-MF in microfiche. Sandia National Laboratory Report No. SAND86-7161, December 1986. 124 p, 45 fig, 8 tab, 75 ref, 8 append. DOE Contract DE-AC04-76DP00789.

Descriptors: *Path of pollutants, *Solute transport, *Tracers, *Culebra Dolomite, *Groundwater movement, *Sandia National Labs, *Model studies, *Waste disposal, *Simulation analysis, *Disposal sites, Pump wells, Test well, Monitoring, Mathematical studies, Geologic fractures, Flow profiles.

Tracer tests utilizing conservative organic tracers were conducted in the Culebra Dolomite Member of the Rustler Formation at the locations of the H-2, H-3, H-4, and H-6 hydropads. The objective of this report is to present a quantitative evaluation of the physical solute-transport parameters of the Culebra dolomite at the H-3 and H-4 hydropad locations from interpretation of the tracer-test data. The interpretive approach for analyzing the tracer-breakthrough curves at the pumping well first consisted of estimating the appropriate governing processes using the information base for each specific hydropad. The simulation model accounted for advective-dispersive transport in the fracture and diffusive transport in the matrix. Calibration of the tracer-breakthrough curves included conducting a parameter sensitivity analysis on longitudinal dispersivity, tortuosity, matrix porosity, fracture porosity, effective matrix block size, pumping rate, initial tracer-input distribution, and distance between pumping and tracer-input distribution, and distance between pumping and tracer-addition wells. Calibration of the tracer-breakthrough curves for the H-3 tracer test resulted in longitudinal dispersivities from 5 to 10% of the flow path (well-separation distance), a fracture porosity of 0.0019, and effective matrix block sizes of 0.25 to 2.1 m. Results obtained from tracer test suggest that fracture flow and matrix diffusion dominate solute transport in the Culebra at the H-3 hydropad. Further, the parameters derived to fit the tracer-breakthrough curves are thought to be consistent with the physical conceptualization of the Culebra at the H-3 hydropad. Qualitatively, the observed tracer-breakthrough curves could be simulated by representing the Culebra with a layered system of higher- and lower-permeability units. In this system, transport would be dominated by the higher-permeability zones with diffusive interaction with the lower-permeability zones. No evidence was obtained to indicate that transport of the tracers had occurred through fractures. (Lantz-PTT)
W87-07029

OXYGEN UPTAKE STUDIES ON VARIOUS SLUDGES ADAPTED TO A WASTE CONTAINING CHLORO-, NITRO- AND AMINO-SUBSTITUTED XENOBIOTICS,
Birmingham Univ. (England). Biochemical Engineering Section.
For primary bibliographic entry see Field 5D.
W87-07056

MIXING CUP AND THROUGH-THE-WALL MEASUREMENTS IN FIELD-SCALE TRACER TESTS AND THEIR RELATED SCALES OF AVERAGING,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2F.
W87-07067

STUDIES IN THE RATIO TOTAL MERCURY/METHYLMERCURY IN THE AQUATIC FOOD CHAIN,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-07071

UPTAKE AND ELIMINATION BY FISH OF POLYDIMETHYLSILOXANES (SILICONES) AFTER DIETARY AND AQUEOUS EXPOSURE,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
A. Opperhuizen, H. W. J. Damen, G. M. Asyee, and, J. M. D. Van der Steen, and O. Hutzinger.
Toxicological and Environmental Chemistry TXECBP, Vol. 13, No. 3/4, p 265-285, January 1987. 9 fig, 2 tab, 21 ref.

Descriptors: *Path of pollutants, *Silicones, *Polydimethylsiloxanes, *Population exposure, *Bioaccumulation, Polymers, Tissue analysis, Fish, Diets, Hydrophobicity, Organic compounds.

$lthough several polydimethylsiloxane oligomers are taken up by fish after dietary and aqueous exposure, they do not significantly accumulate, despite their high hydrophobicity compared to polychlorinated biphenyls. For both cyclic and linear oligomers with less than fourteen silicon units, this is probably due to short half life times. For all oligomers these were less than 4.5 days. Linear oligomers with more than fourteen silicon units were not detectable in fish, probably due to a lack of uptake. (Author's abstract)
W87-07074

EFFECT OF SALINITY ON MERCURY-METHYLATING ACTIVITY OF SULFATE-REDUCING BACTERIA IN ESTURINE SEDIMENTS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
G. C. Compeau, and R. Bartha.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 2, p 261-265, February 1987. 2 fig, 2 tab, 27 ref.

Descriptors: *Path of pollutants, *Sulfate-reducing bacteria, *Bacteria, *Mercury, *Biomethylation, *Estuarine sediments, *Salinity, Inhibition, Molybdates, Methylation, Methanogenesis, Anoxic sediments, Heavy metals.

The biomethylation of mercury was measured in anoxic estuarine sediments that ranged in salinity from 0.03 to 2.4% with or without added molybdate, an inhibitor of sulfate reducers. Mercury methylation was inhibited by molybdate by more than 95%, regardless of sediment salinity. In the absence of inhibitor, high-salinity sediments methylated mercury at only 40% of the level observed in low-salinity sediments. In response to molybdate inhibition of sulfate reducers, methanogenesis increased up to 258% in high-salinity sediments but only up to 25% in low-salinity sediments. In contrast to an earlier low-salinity isolate, a Desulfovibrio desulfuricans strain from high-salinity sediment required 0.5 M sodium for optimal growth and mercury methylation activity. The formation of negatively charged mercuric chloride complexes at high salinity did not noticeably interfere with the methylation process. Results of these studies demonstrate that sulfate reducers are responsible for mercury methylation in anoxic estuarine sediments, regardless of the prevailing salinity. (Author's abstract)
W87-07076

WATERSHED FACTORS AFFECTING STREAM ACIDIFICATION IN THE WHITE MOUNTAINS OF NEW HAMPSHIRE, USA,
IEP, Inc., Northborough, MA.
S. W. Bailey, J. W. Hornbeck, C. W. Martin, and D. C. Buso.
Environmental Management EMNGDC, Vol. 11, No. 1, p 53-60, January 1987. 1 fig, 3 tab, 13 ref.

Descriptors: *Acid streams, *Acid rain, *Path of pollutants, *Watersheds, *White Mountains, Geology, Hydrology, Streams, New Hampshire, Minerals, Groundwater, Rocks, Water chemistry.

The streams tributary to acidic Cone Pond, pH 4.5-4.8, and circumneutral Black Pond, pH 5.3-6.4, in the White Mountains of New Hampshire, USA, were monitored for a year. The watersheds of these two ponds were characterized in terms of geology and stream hydrology. Chemical gradients and patterns in rock weathering and groundwater discharge explain many of the differences in mineral content and acidity of the streams. The rocks of Black watershed produced an average of ten times the equivalent of basic cations as rocks from Cone watershed. This is on the same order as the difference in acidity of the two streams. Downstream changes in stream chemistry follow differing patterns, but reflect the same principle of residence time and water path length controlling chemical evolution of streamwater. Watershed and aquatic managers may use these parameters in an inexpensive and simple assessment of the susceptibility of individual streams and ponds to acidification. A method is recommended to determine quickly the potential influence of bedrock type to aquatic chemistry. (Author's abstract)
W87-07084

BEHAVIOR OF SENSITIVITIES IN THE ONE-DIMENSIONAL ADVECTION-DISPERSION EQUATION: IMPLICATIONS FOR PARAMETER ESTIMATION AND SAMPLING DESIGN,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W87-07107

IMPORTANCE OF SEDIMENT SULFATE REDUCTION TO THE SULFATE BUDGET OF AN IMPOUNDMENT RECEIVING ACID MINE DRAINAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. T. Herlihy, A. L. Mills, G. M. Hornberger, and A. E. Bruckner.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 287-292, February 1987. 3 fig, 4 tab, 33 ref. NSF Grant DEB82-06827.

Descriptors: *Sulfate-reducing bacteria, *Sulfates, *Acid mine drainage, *Path of pollutants, *Fate of pollutants, *Sediments, *Lake sediments, *Lakes, Chemical reactions, Alkalinity, Chemical properties, Chemical reduction, Reservoirs, Acidic water, Mine drainage, Lake Anna, Virginia, Hydrogen ion concentration.

Alkalinity generation by bacterial sulfate reduction (SR) was shown to be an important neutralizing agent for acid mine drainage and acid precipitation in lakes and reservoirs. In order to quantify the importance of SR in an acidified system, a sulfate influx-efflux budget was constructed for Lake Anna, an impoundment in central Virginia that receives acid mine drainage. For the 1983 and 1984 water years, 48% (namely 800000 kilograms) of the sulfate entering the impoundment was removed from the water column within the first 2 kilometers of the arm of the lake receiving the pollution. SR rates measured using S35-labeled sulfate were extrapolated across the surface area of this arm of the lake; this calculated amount of sulfate removed was equal to 200% of the sulfate removed from the lake as calculated in the budget. The calculated alkalinity generated by this sulfate removal was more than twice that necessary to account for the observed pH increase in the impoundment. The magnitude of the sulfate removal and alkalinity generation demonstrates the quantitative importance of SR as an ecosystem level buffering mechanism. (Author's abstract)
W87-07109

SALTWATER INTRUSION IN AQUIFERS: DEVELOPMENT AND TESTING OF A THREE-DIMENSIONAL FINITE ELEMENT MODEL,
GeoTrans, Inc., Herndon, VA.
P. S. Huyakorn, P. F. Andersen, J. W. Mercer, and H. O. White.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 293-312, February 1987. 16 fig, 2 tab, 38 ref, 3 append.

Descriptors: *Aquifers, *Saline water intrusion, *Model studies, *Coastal aquifers, *Saline water, Mathematical models, Mathematical equations, Mathematical studies, Model testing, Simulation, Confined aquifers, Groundwater, Fluid flow, Solute transport, Algorithms, Computers.

A three-dimensional finite element model is developed for the simulation of saltwater intrusion in single and multiple coastal aquifer systems with either a confined or phreatic top aquifer. The model formulation is based on two governing equations, one for fluid flow and the other for salt transport. Density coupling of these equations is accounted for and handled using a Picard sequential solution algorithm with special provisions to enhance convergence of the iterative solution. Flexibility in the formulation allows for either three-dimensional simulations or quasi three-dimensional analytical and/or numerical approximations. Spatial discretization of three-dimensional regions is performed using a vertical slicing approach designed to accommodate complex geometry with irregular boundaries, layering, and/or lateral discontinuity. This approach is effectively combined with the use of simple linear elements such as rectangular and triangular prisms, and composite hexahedra and pentahedra made up of tetrahedra. For these elements, computation of element matrices can be performed efficiently using influence coefficient formulas that avoid numerical integration. New transport influence coefficient formulas are presented for rectangular and triangular prism elements. Matrix assembly is performed slice by slice, and the matrix solution is achieved using a slice successive relaxation scheme. This permits a fairly large number of nodal unknowns (of the order of five to ten thousand) to be handled conveniently on small or medium-size minicomputers. Flexibility of the formulation and matrix handling procedures also allows two-dimensional and axisymmetric problems to be solved efficiently using slice representations. Four examples are presented to demonstrate the model verification and utility. These problems represent a fair range of physical conditions. Where possible, simulation results are compared with previously published solutions. (Author's abstract)
W87-07110

RATES OF ACCUMULATION OF DIELDRIN BY A FRESHWATER FILTER FEEDER: SPHAERIUM CORNEUM,
Huddersfield Polytechnic (England). Dept. of Chemical and Physical Sciences.
M. Borynslawskyj, A. C. Garrood, J. T. Pearson, and D. Woodhead.
Environmental Pollution, Vol. 43, No. 1, p 3-13, January 1987. 1 fig, 5 tab, 10 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Dieldrin, *Insecticides, *Mollusks, Pollutants, England, Textile mill wastes, Industrial wastes, Aquatic animals, Accumulation, Organochlorine compounds, Effluents, Field tests, Adsorption, Temperature effects, Correlation analysis, Gills.

Dieldrin, a persistent organochlorine insecticide, is used as a mothproofer in the textile industry in West Yorkshire, England. Significant amounts remain after application of conventional methods of effluent treatment and are discharged into local rivers and streams in the treated effluent from sewage plants. The rate of dieldrin accumulation by Sphaerium corneum, a small freshwater filter-feeding mollusk found most commonly in rivers and canals, was determined in the field and under controlled conditions in the laboratory. The methods gave comparable results and it was established that Sphaerium attained an equilibrium concentration in its tissues in a short time period and exhibited a bioaccumulation factor of 1000. The rate of dieldrin accumulation by direct uptake from dieldrin in solution was compared to the rate obtained for indirect uptake from dieldrin adsorbed onto particulate material. The primary route of dieldrin uptake into Sphaerium was shown to be by direct partitioning of residues into lipoidal tissues from water. The rate of accumulation was found to increase with temperature in the range of 5 C to 20 C. The frequency of gill cilia beat in relation to accumulation rate was studied in the temperature range and a correlation is shown. (Wood-PTT)
W87-07117

PORE WATER UPAKE BY AGRICULTURAL RUNOFF,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07121

WATER QUALITY DATA ANALYSIS IN CHUNG KANG RIVER,
Asian Development Bank, Manila (Philippines).
B. N. Lohani, and M. M. Wang.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 186-195, February 1987. 2 fig, 5 tab, 17 ref.

Descriptors: *Water pollution control, *Time series analysis, *Model studies, Mathematical analysis, Mathematical models, Planning, Taiwan, Urbanization, Industrial development, Water quality.

The Chung Kang River, located in the middle of Taiwan, Republic of China, is becoming increasingly polluted due to rapid economic development, industrialization, and population growth. It has become necessary to assess water quality data in this river and to examine methods for forecasting water quality in order to develop appropriate control strategies for the future. Box-Jenkins time series analysis of monthly water quality data was conducted. Five years of data (1976-1980) were used for the basic analysis and the data for a sixth year (1981) were used for comparison of results forecast from the models. It was found that the autoregressive models with order one could be used, and forecasting with seasonal data seems to work well when the Box-Jenkins technique is combined with nonparametric transformation. Further, the three model structure selection criterion used in the analysis shows very good consistency in selecting the best model. (Airone-PTT)
W87-07130

ORGANOPHOSPHATE DICHLORVOS INDUCED DOSE-RELATED DIFFERENTIAL ALTERATIONS IN LIPID LEVELS AND LIPID PEROXIDATION IN VARIOUS REGIONS OF THE FISH BRAIN AND SPINAL CORD,
Jawaharlal Nehru Medical Coll., Aligarh (India). Interdisciplinary Brain Research Centre.
For primary bibliographic entry see Field 5C.
W87-07139

EXTRACTABILITY AND BIOAVAILABILITY OF ZINC, NICKEL, CADMIUM, AND COPPER IN THREE DANISH SOILS SAMPLED 5 YEARS AFTER APPLICATION OF SEWAGE SLUDGE,
Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
J. R. Sanders, T. M. Adams, and B. T. Christensen.
Journal of Science, Food and Agriculture JSFAAE, Vol. 37, No. 12, p 1155-1164, December 1986. 1 fig, 8 tab, 18 ref.

Descriptors: *Sludge, *Heavy metals, *Waste disposal, *Land disposal, *Bioaccumulation, Chelation, Chelating agents, Sludge utilization, Beets, Barley, Calcium chloride, Zinc, Nickel, Cadmium, Copper.

The chemistry and bioavailability of added metals have been studied frequently, but over relatively short periods following sludge application. Long term effects have rarely been measured. However, such information is indispensible to set criteria for applying sludge to agricultural soils. Soils from three Danish experiments testing identical quantities of sewage sludge were sampled 5 years after application ceased. Chemical studies involving single and sequential extractions, displaced solution measurements and plant uptake experiments showed that sludge-added Zn, Ni, Cd and Cu persisted in extractable and bioavailable forms in the top-soils and that soil pH and texture influenced their chemistry and availability. The EDTA-extractabilities of native and of sludge-added Cd were similar, but native Zn, Ni and Cu were less extractable than sludge-added metals. 0.1 M calcium chloride was the best extractant for predicting plant uptake. In some cases a chelating extractant combined with pH measurements is suitable if a single reagent is to be used for all four metals. (Airone-PTT)
W87-07142

CONTAMINATION OF THE AIR AND OTHER ENVIRONMENT SAMPLES OF THE ULM REGION BY RADIOACTIVE FISSION PRODUCTS AFTER THE ACCIDENT OF THE CHERNOBYL REACTOR (BELASTUNG DER LUFT UND ANDERER DURCH NIEDERSCHLAG KONTAMINIERTER UMWELTPROBEN DES ULMER RAUMES MIT RADIOAKTIVEN SPALTPRODUKTEN NACH DEM REAKTORUNFALL IN TSCHERNOBYL),
Ulm Univ. (Germany, F.R.). Sektion Analytik und Hoechstreinigung.
V. Krivan, K. P. Egger, R. Hausbeck, and W. Schmid.
Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 7, p 597-602, December 1986. 3 fig, 4 tab, 16 ref.

Descriptors: *Radioactive wastes, *Drinking water, *Nuclear reactors, *Path of pollutants, *Chernobyl, *Ulm, *Fallout, Industrial wastes, Plants, Radioactivity, Contamination.

Since April 30, 1986, the radioactivity of the fission products released by the accident of the Chernobyl reactor has been measured in the air of the city of Ulm. The airborne dust samples were collected with flow calibrated samplers on cellulose acetate membrane filters and counted with a high resolution gamma ray spectrometer. The radioactivity measurements were later extended to other relevant environmental samples contaminated by radioactive atmospheric precipitates including grass, spruce, needles, mosses, lichens, various kinds of food, drinking water, asphalt and concrete surface layers, municipal sewage sludge and sewage sludge ash. Some results are (1) the activities of all relevant radio-nuclides in drinking water samples were lower than detection limits in July and August, (2) plants became strongly contaminated on the surfaces of leaves. (Airone-PTT)
W87-07143

REVIEW OF SEDIMENT/WATER QUALITY INTERACTION WITH PARTICULAR REFERENCE TO THE VAAL RIVER SYSTEM,
National Inst. for Water Research, Pretoria (South Africa).
D. C. Grobler, D. F. Toerien, and J. N. Rossouw.
Water S. A. WASADV, Vol. 13, No. 1, p 15-22, January 1987. 6 fig, 59 ref.

Descriptors: *Sediments, *Vaal River, *Turbidity, *Salinity, *Eutrophication, *Water pollution effects, Adsorption, Industrial development, Mining, Phytoplankton, Water quality.

Sediment affects water quality in many ways. The most obvious effect is that of increasing turbidity. In the lower Vaal River this effect is being countered by the increasing salinity brought about by mining, industrial and domestic effluents, and irrigation return flow. A greater light penetration results in extensive blooms of rooted underwater macrophytes in sections of the lower Vaal River, but could also increase the likelihood of phytoplankton blooms. Sediment modifies the impact of pollution on the aquatic environment. Sorption of pollutants on sediments alters their fate and their positional- and bio-availability in the aquatic environment. Sediment is one of the important sinks for pollutants; however, under certain circumstances pollutants can be remobilized. These effects of sediment on water quality are of major importance in systems such as the Vaal River which carry large sediment loads. Planning and management should take these into account. Most management-oriented water quality models ignore important effects of sediment/pollutant interaction on water quality. This poses a serious limitation to the appli-

cation of these models to sediment-rich systems. Research to rectify this is suggested. (Author's abstract)
W87-07150

CHEMICAL COMPOSITION OF THE PALMIET RIVER WATER,
Durban-Westville Univ. (South Africa). Dept. of Chemistry.
A. L. du Preez, and G. T. de Villiers.
Water S. A. WASADV, Vol. 13, No. 1, p 23-30, January 1987. 3 fig, 7 tab, 7 ref.

Descriptors: *Chemical analysis, *River systems, *Baseline studies, *Water pollution sources, *Path of pollutants, *Palmiet River, Aluminum, Iron, Manganese, Trace levels, Management planning, Catchments areas, Seasonal variation.

The water quality of the Palmiet River near Durban was determined over a period of two years to afford a baseline for future studies in the catchment and to give an indication as to the present state of the river. There is a deterioration of water quality downstream. The Pinetown Central Business District has a marked impact on the river. Analyte values in the Palmiet River are noticeably higher than those of the Umgeni River, relative to other rivers in Southern Africa. Na(+), Cl(-), SO4(2-), Ca(2+), Mg(2+), K(+), NH4(+)-N, NO3(-)-N, As, B, Ba, Fe, Mn, Pb, and Zn values are relatively high. Measured by world standards, Al, Mn, and Fe values are high throughout the year, while other analytes randomly exceed world norms thus pointing to the occurrence of both continuous and random pollution in the Palmiet River. Macro-analytes exhibit well defined seasonal and spatial trends while micro-analytes generally do not. (Author's abstract)
W87-07151

PREDICTING BASEFLOW ALKALINITY AS AN INDEX TO EPISODIC STREAM ACIDIFICATION AND FISH PRESENCE,
Pennsylvania State Univ., University Park.
D. R. DeWalle, R. S. Dinicola, and W. E. Sharpe.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 29-35, February 1987. 3 fig, 4 tab, 7 ref.

Descriptors: *Acidification, *Fish populations, *Model studies, *Baseflow alkalinity, *Acid rain, *Alkalinity, *Geohydrology, *Streams, Pennsylvania, Prediction, Trout, Alkalinity, Carbonate rocks.

Regression models to predict baseflow alkalinity from basin hydrogeology were developed and verified for headwater streams on the Laurel Hill anticline in southwestern Pennsylvania. Predicted baseflow alkalinities were then used to estimate sensitivity to acidification and presence of trout (Salvelinus fontinalis) populations for 61 headwater streams. Sensitivity classifications were verified by surveying trout populations. Geologic variables relating to the carbonate rock burial depth, extent of carbonate rock recharge areas, and length of stream channel flowing through effluent carbonate rock outcrops were much more useful in predicting baseflow alkalinity than areal extent of carbonate rocks. Baseflow alkalinity was not well related to status of trout populations on these anticlinal basins, especially on noneffluent basins where bedrock dip exceeded surface slope. (See also W87-07179) (Author's abstract)
W87-07178

TRANSPORT OF ROAD-SURFACE SEDIMENT THROUGH EPHEMERAL STREAM CHANNELS,
Weyerhaeuser Co., Tacoma, WA.
S. H. Duncan, R. E. Bilby, J. W. Ward, and J. T. Heffner.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 113-119, February 1987. 4 fig, 1 tab, 13 ref.

Descriptors: *Sediment transport, *Road runoff, *Ephemeral streams, *Path of pollutants, *Water pollution sources, Discharge, Streamflow, Sediments, Channels, Streams, Washington, Oregon, Drainage.

Since the majority of road drainage points in western Washington and Oregon enter small, often ephemeral streams rather than large, fish-bearing waters, impact of road-surface sediment on biota in permanent streams depends, to a large extent, on transport through these small watercourses. A series of experimental additions of road-surface sediment was made to two ephemeral streams to examine the downstream transport of this material as a function of discharge and channel characteristics. These small streams were found to store large amounts of sediment washed from road surface. In no instance did either stream transport more than 45 percent of the added material to their mouths, distances of 95 and 125 m. Larger-sized sediment particles were delivered at a lower rate than finer material. Added sediment <0.063 mm in size was transported efficiently through the systems at all but the lowest flows tested. Material between 0.5 and 0.063 mm and from 2.0 to 0.5 mm in size were retained at progressively higher rates, with sediment in the coarser size category never exceeding a delivery of 10 percent of the added material. There were significant differences in the transport of sediment in the two larger size categories between the two streams. These differences were due to a much greater amount of woody debris in the stream with the lower delivery rates, which acted to trap and hold sediment, as well as a slightly longer and less steep channel. (Author's abstract)
W87-07186

PRIORITIZING AREAS FOR STATEWIDE GROUNDWATER MONITORING,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7A.
W87-07195

ORGANOCHLORINE RESIDUES IN RIVER PO SEDIMENT: TESTING THE EQUILIBRIUM CONDITION WITH FISH,
Istituto di Ricerca sulle Acque, Milan (Italy).
For primary bibliographic entry see Field 5A.
W87-07206

COMPARATIVE KINETICS STUDY OF THE EVOLUTION OF FRESHWATER AQUATIC TOXICITY AND BIODEGRADABILITY OF LINEAR AND BRANCHED ALKYLBENZENE SULFONATES,
Rhone-Poulenc S.A., Paris (France).
For primary bibliographic entry see Field 5C.
W87-07207

KINETICS OF BIODEGRADATION OF NITRILOTRIACETIC ACID (NTA) IN AN ESTUARINE ENVIRONMENT,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
R. J. Larson, and R. M. Ventullo.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 166-179, October 1986. 3 fig, 4 tab, 69 ref.

Descriptors: *Isotope studies, *Fate of pollutants, *Nitrilotriacetic acid, *Estuaries, *Biodegradation, *Kinetics, Salinity, Organic carbon, Model studies, Bacteria, Microbial degradation, Organic compounds.

The effects of salinity and dissolved organic carbon (DOC) on the kinetics of biodegradation of nitrilotriacetic acid (NTA) were studied in a Canadian estuary with a prior history of NTA exposure. Kinetic parameters for degradation of 14C-labeled NTA, maximum velocity (V sub max) and first-order rate constant (k sub l), were estimated by nonlinear regression models from velocity and time-course plots, respectively. The distribution of bacteria with NTA-degrading capability was also determined at various salinities and DOC levels by the 14C-most-probable-number (14C-MPN) technique. In general, NTA degradation was rapid in estuarine water over the range of salinities and DOC levels tested. Mean V sub max and K sub l values (+ or - standard deviation) across several sampling periods averaged 4753 + or - 2849 ng/liter/hr and 0.32 + or - 0.19/day, respectively. The estimated half-life for NTA degradation in estuarine water, based on the mean K sub l value, was 2 days. Degradation rates for NTA were relatively insensitive to changes in salinity or DOC values, and neither of these two parameters had significant effects on NTA degradation at the microbial community or individual cell levels. Based on 14C-MPN results, the distribution of estuarine bacteria capable of degrading NTA was broad and not related to salinity or DOC levels. The NTA degraders appeared to be indigenous members of the estuarine microbial community and not wastewater-associated microorganisms. (Author's abstract)
W87-07210

TISSUE DISTRIBUTION OF 14C-LABELED RESIDUES OF AMINOCARB IN BROWN BULLHEAD (ICTALURUS NEBULOSUS LE SUEUR) FOLLOWING ACUTE EXPOSURE,
Ottawa Univ. (Ontario). Dept. of Biology.
G. M. Richardson, and S. U. Qadri.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 180-186, October 1986. 4 tab, 14 ref.

Descriptors: *Path of pollutants, *Isotope studies, *Aminocarb, *Bullhead, Population exposure, Tissue analysis, Sublethal effects, Fish physiology, Liver.

Young brown bullhead (Ictalurus nebulosus) were exposed to aminocarb (4-dimethylamino-3-methylphenyl N-methylcarbamate) at lethal and sublethal concentrations and the tissue distribution of total unspecified residues was examined. The concentration of residues in each tissue increased with the concentration of exposure. The liver and stomach/intestine accumulated the largest concentrations of residues of all the tissues studied except for the abdominal fat deposit, which could not be evaluated at all exposure concentrations. These two tissues also displayed a steady increase in the proportion of the total body burden of aminocarb residues during 4 days of exposure to 0.092 mg aminocarb/liter. The proportion of residues in the carcass at this level of exposure decreased steadily over this same period, but was more similar to that found during exposure at the two lethal concentrations (92.7 and 159.3 mg/liter) as opposed to that found at the intermediate, nonlethal exposure level of 41.1 mg/liter. For all tissues examined, the concentration of residues at the end of 4 days of exposure to 0.092 mg/liter was significantly lower than the peak concentration reached during the exposure period, and clearance of residues was found to be relatively rapid. (Author's abstract)
W87-07211

PETROLEUM HYDROCARBONS IN THE MEDITERRANEAN SEA: A MASS BALANCE,
Bermuda Biological Station for Research, Ferry Reach.
K. A. Burns, and A. Saliot.
Marine Chemistry MRCHBD, Vol. 20, No. 2, p 141-157, November 1986. 4 tab, 62 ref.

Descriptors: *Model studies, *Path of pollutants, *Fate of pollutants, *Hydrocarbons, *Mediterranean Sea, Petroleum, Mass balance, Transport, Tracers.

Over three quarters of a million tons of oil were estimated to be introduced annually into the Mediterranean Sea from land-based and open-sea discharges. This paper is a critical assessment of data available through 1983 on the distribution of petroleum-derived hydrocarbon residues and the biogeochemical processes controlling the transport and fate of organic contaminants in this regional sea ecosystem. Inputs, outputs and ecosystem partitioning or inventories are computed and a complete mass balance model is proposed. The approach raises several implications with respect to strategies for the sampling and analysis of organic contaminants in ocean ecosystems. The report also provides a basis on which to evaluate the effectiveness of recent discharge regulations in reducing pollution loads in the Mediterranean. The agreement between calculated fluxes, inventories and input time scales demonstrates the usefulness of

organic contaminants as markers for the development of global and ocean flux models. (Author's abstract)
W87-07218

ANNOTATED NITROGEN BUDGET CALCULATION FOR THE NORTHERN ADRIATIC SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 2L.
W87-07219

METAL MOVEMENT IN SLUDGE-AMENDED SOILS: A NINE-YEAR STUDY,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
D. E. Williams, J. Vlamis, A. H. Pukite, and J. E. Corey.
Soil Science SOSCAK, Vol. 143, No. 2, p 124-131, February 1987. 9 fig, 3 tab, 22 ref.

Descriptors: *Sludge disposal, *Land disposal, *Heavy metals, *Path of pollutants, Density, Tillage, Sludge, Metals, Soil profiles.

Sewage sludges were incorporated annually into the surface 20 cm of Dublin loam over a period of 8 yr. Sludge rates varied from 0 to 225 metric tons per hectare (t/ha) in increments of 45 t. Data presented cover a 9-yr period, which includes a final year in which no sludge was added to the soil. Metal concentrations found by analysis were higher in the surface soil only when the concentration of metal in the added sludge exceeded that found in the untreated soil. Metal availability, expressed as DTPA/HNO3 ratios, was greater in the acid Oakland-sludge-treated soils for Cd, Zn, Ni, Co, Fe, and Mn than the neutral to alkaline Pacheco-sludge-treated soils. The increased soil acidity and the high percentage availability of metals in the Oakland plots did not result in an increased metal movement within the soil profile. Metals tended to remain in the zone of soil incorporation over the 9-yr period in spite of sludge additions amounting to 1800 t/ha for Pacheco and 1440 t/ha for Oakland sludge. The apparent movement of Zn and Cd 5 cm below the area of sludge incorporation may be an artifact resulting from inaccurate depth measurements due to the decrease in bulk densities. Rototilling of the field resulted in a lateral movement of soil and sludge particles downslope from the plot areas. This soil movement made it impossible to balance metals added in sludge with metal contents of the soil. No significant movement of metals occurred in the year following termination of sludge additions. (Author's abstract)
W87-07225

MECHANISMS OF PRODUCTION AND FATE OF ORGANIC PHOSPHORUS IN THE NORTHERN ADRIATIC SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 2L.
W87-07231

NUTRIENT REGENERATION IN SHALLOW-WATER SEDIMENTS OF THE ESTUARINE PLUME REGION OF THE NEARSHORE GEORGIA BIGHT, USA,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2L.
W87-07232

APPRAISAL OF TESTS TO PREDICT THE ENVIRONMENTAL BEHAVIOUR OF CHEMICALS.
Scientific Committee on Problems of the Environment, Paris (France).
Scope 25. John Wiley and Sons, Chichester, England, 1985. Edited by Patrick Sheehan, Friedhelm Korte, Werner Klein, and Philippe Bourdeau. 380 p.

Descriptors: *Path of pollutants, *Fate of pollutants, *Toxins, *Testing procedures, *Biodegradation, *Water pollution sources, Sediments, Air pollution, Bioaccumulation, Food chains, Soil dynamics, Degradation, Prediction, Toxicity, Ecological effects, Environmental effects, Models studies, Microbial degradation.

A working group of the scientific Committee on Problems of the Environment (SCOPE), a committee established by the International Council of Scientists, prepared an appraisal of tests used to predict the fate of chemicals in the environment. The appraisal was made to facilitate hazard assessments of chemicals released into the environment for specific organisms or the ecosystem as a whole. The first chapter examines the role and nature of environmental testing methods. Chapter 2 discusses the behavior of chemicals in the atmosphere by reviewing atmospheric chemistry, the degradation of chemicals in the gas, liquid, and the adsorbed phases, and by presenting test methods for abiotic degradability. In Chapter 3 the behavior of chemicals in water, sediments and soil is studied. The prediction, transformation, degradation, and accumulation of chemicals in biota are outlined in Chapter 4. In Chapter 5 prediction of the movement of chemicals between environmental compartments (air-water-soil-biota) is considered. Regulatory needs for tests to predict the behavior of environmental chemicals are discussed in Chapter 6. The final chapter contains conclusions about the tests used to predict the behavior of chemicals in the environment and recommendations for improvements in field and laboratory tests. (See also W87-07234 thru W87-07242) (Geiger-PTT)
W87-07233

ROLE AND NATURE OF ENVIRONMENTAL TESTING METHODS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
For primary bibliographic entry see Field 5A.
W87-07234

ABIOTIC CHEMICAL CHANGES IN WATER,
Bayer A.G., Wuppertal (Germany, F.R.).
H. Hulpke, and R. Wilmes.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 119-135, 48 ref.

Descriptors: *Chemical reactions, *Fate of pollutants, *Aquatic environment, *Degradation, *Oxidation, *Testing procedures, Ecosystems, Volatility, Hydrolysis, Biodegradation, Physicochemical properties, Bioaccumulation, Adsorption, Organic compounds, Hazardous materials, Model studies.

Substances in the aquatic ecosystem are exposed to numerous physical, chemical and biochemical processes which can transform and then degrade them or transfer them into the biota, sediments or atmosphere. A substance dissolved in water can be eliminated from the water without undergoing a chemical change by volatilization from the water, adsorption on the sediment, or by bioaccumulation. The most important demonstrated abiotic degradation pathways in water are hydrolysis, direct photodegradation and radical oxidation. Direct photodegradation, sensitized photodegradation, indirect photodegradation and oxidation, and anthropogenically induced transformations of organic compounds in water are reviewed. These reactions can be simulated in laboratory experiments in model ecosystems, for which conditions should be chosen to correspond to those in the environment. Substances can be compared with respect to their abiotic degradability when test conditions are standardized. Such laboratory tests provide a measure of the specific behavior of a chemical under conditions which do not mimic the natural environment but approximate important boundary conditions. Neither accepted test methods nor experimental research can possibly simulate the total multitude of reaction conditions operable in the aquatic environment. (See also W87-07233) (Geiger-PTT)
W87-07235

SEDIMENTS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
I. Scheunert.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 137-168, 1 tab, 158 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Sediment transport, *Testing procedures, *Sediments, *Adsorption, Suspended solids, Food chains, Bioaccumulation, Degradation, Model studies, Ecosystems, Biodegradation, Volatility.

Results of laboratory tests reported thus far on adsorption/desorption, remobilization and bioaccumulation of chemicals in sediments reveal that sediments play a key role in the distribution of chemicals in the aquatic environment. This key role is confirmed by both laboratory model ecosystem and field test data. However, there is no standardized and internationally recognized test procedures for any physical or chemical process related to sediments. An OECD adsorption/desorption test for soil and OECD biodegradation tests for water can, with certain modifications, be applied to sediments. The OECD test for adsorption/desorption and available tests for volatility should be adapted to sediments and then standardized. Similarly, for the accumulation and remobilization of chemicals from sediments due to the activity of organisms such as worms, standard test should be developed. Only sporadic experimental data for individual chemicals is available for some of the chemical and biochemical processes and interactions in sediments which are important in determining the final global fate of chemicals. Few field studies have been conducted to verify the relevance of reported test data to prodict the environmental behavior of chemicals in natural sediments. Laboratory tests as well as field studies should be improved to better understand the role of sediments in the environmental behavior of chemicals. (See also W87-07233) (Geiger-PTT)
W87-07236

SOIL SYSTEMS,
Binnie and Partners, Lima (Peru).
F. P. W. Winteringham.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 169-192, 2 fig, 77 ref.

Descriptors: *Fate of pollutants, *Testing procedures, *Soil profiles, *Soil-water-plant relationships, *Biodegradation, *Path of pollutants, Microbial degradation, Runoff, Leaching, Model studies, Soil tests, Prediction, Research priorities, Soil erosion, Recycling, Waste disposal, Soil contamination.

The factors affecting the behavior of an environmental chemical in the soil profile (spatial variability, atmosphere, irrigation and flooding, agrochemical usage, waste recycling and dumping, erosion, runoff, leaching volatilization, photodecomposition, plants, animals, and microbial degradation) are described. Simple equations for predicting concentrations on the basis of known or determined input and disappearance rates are given. Laboratory tests and models are briefly reviewed and discussed. These relate mainly to disappearance factors such as volatilization, erosion and runoff, leaching and mobility in the soil profile, and the chemical-biotic interactions such as plant uptake and metabolism, and microbial degradation. An optimal use of laboratory tests and models to predict chemical fate is suggested, and the limitations imposed by temporal and spatial variability of the ecosystem is emphasized. The value of comparative testing with well-established environmental chemicals is also stressed. A simple laboratory test is needed to characterize overall field soil biomass and its activity. Provisions should also be made for the capacity of insects, fungi, bacteria, plants (weeds), and even rodents to evolve into populations resistant to certain toxins such as pesticides. Isotopic tracer techniques in this aspect of ecotoxicology are particularly valuable provided care is

exercised in interpreting data on the distribution of isotopic labels within a model ecosystem. (See also W87-07233) (Geiger-PTT)
W87-07237

DEGRADATION BY MICROORGANISMS IN SOIL AND WATER,
Institut National de Recherche Chimique Appliquee, Vert le Petit (France).
R. Cabridenc.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 213-232, 58 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Microbial degradation, *Soil bacteria, *Testing procedures, *Path of pollutants, Organic compounds, Biochemical oxygen demand, Organic carbon, Aquatic environment, Surfactants, Metabolism, Temperature, Light intensity, Aquatic bacteria.

The processes governing the biodegradation of organic substances by aquatic and soil microorganisms are reviewed. These processes are affected by a wide range of abiotic and biotic factors such as the composition of the environment, temperature, light intensity, and the characteristics of the microbial populations involved. The speed at which organic substances are decomposed by microorganisms depends on the structure and physical properties of the substance. Laboratory tests for estimating the biodegradability of organic substances most commonly focus on the aerobic biodegradability of organic substances in fresh water (river die-away test), in model water treatment plants (treatability test), and less commonly in a marine environment, under anaerobic conditions, or in soil. Several tests for the biodegradability of chemicals in an aquatic environment are reviewed. These include: functional or primary tests, tests on anionic surfactants, tests on non-ionic ethoxylated surfactants, a test on a cationic surfactants, the OECD test and the Porous Pot test, tests of ultimate or total biodegradability, and tests using studies of changes in oxygen consumption, dissolved organic carbon or CO2 release. The principles of soil biodegradability tests are identical to those used in water, but for soil, the soil type must be taken into account. A method based on the study of 14CO2 release over a period of time is now recommended by the OECD for measuring the biodegradation of substances in soil. (See also W87-07233) (Geiger-PTT)
W87-07238

MODELLING OF BIOTIC UPTAKE,
National Research Council of Canada, Ottawa (Ontario).
J. R. Roberts, and J. T. McGarrity.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 233-241, 2 fig, 2 tab, 35 ref.

Descriptors: *Fate of pollutants, *Model studies, *Path of pollutants, *Bioaccumulation, *Biological magnification, *Testing procedures, Fish, Organic compounds, Regression analysis, Mathematical models, Absorption, Chlorinated hydrocarbons, Metabolism.

The level of pollutant accumulated by an organism reflects the dynamic balance between rate of uptake and rate of clearance. Uptake rate is affected by the nature of the medium, the nature of the chemical and the specific energy requirements of the organism. A simple three-compartment model and assumed first-order kinetics are used to describe the uptake and accumulation of organic chemicals from water and food vectors in fish. This model can be used to determine the bioconcentration factor (BCF), the accepted indicator of the tendency of a chemical to accumulate in the tissues of the organism. The steady state BFCs of a large number of organic chemicals in fish have been correlated with various indicators of lipophilicity. Using these relations, it is possible to estimate BCFs from the physical properties of a chemical. Estimates of BCFs become complicated by compounds that do not readily pass through membranes or that are easily metabolized. The correlation of bioaccumulation to lipophilicity in turn means that adiposity will be of particular concern due to its profound effect on the clearance rate of organochlorines. (See also W87-07233) (Geiger-PTT)
W87-07239

ACCUMULATION IN AQUATIC ORGANISMS.
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 243-255, 2 fig, 1 tab, 37 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Fate of pollutants, *Bioaccumulation, *Aquatic animals, *Biological magnification, *Organic compounds, Chlorinated hydrocarbons, Testing procedures, Fish, Fish food, Food chains, Model studies, Excretion, Mathematical models, Physicochemical properties.

The bioconcentration factor (BCF), the quotient of the concentration of a chemical in an organism and the ambient medium, is an important factor in assessing the probability of toxic effects being encountered by man. Criteria for selection of the test organism require that the organism accumulate the compound without being killed, provide sufficient material (body size) for analysis, be hardy enough to survive in the laboratory, and exhibit the same BCF for all organisms of a given species. When performing bioconcentration tests, the test organism must be exposed for four half-lives to approach >90% of the theoretical BCF. BCFs at steady state can be determined using static, semistatic, and flow-through tests. The method chosen will depend on the type of substances being tested, their physicochemical properties (water solubility and n-octanol:water partition coefficient), the test organisms, the type of environment for which predictions have to be made, and economic considerations. The determination of the elimination (depuration) rate constant and the use of physicochemical data to predict the BCF are described. To approach the problem of the contribution of biomagnification within the bioaccumulation process, some simplifications may be adopted: constant substance concentration in water; same BCF-values for consumer and food; quantitative absorption of the substance associated with food by consumer; persistence of the compound; and a constant feeding rate. Standardization of laboratory procedures and verification experiments under field conditions will be essential in future work. (See also W87-07233) (Geiger-PTT)
W87-07240

PREDICTING THE MOVEMENT OF CHEMICALS BETWEEN ENVIRONMENTAL COMPARTMENTS (AIR-WATER-SOIL-BIOTA).
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
Inst. fuer Oekologische Chemie.
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 285-332, 6 tab, 173 ref.

Descriptors: *Fate of pollutants, *Soil-water-plant relationships, *Path of pollutants, *Testing procedures, *Physicochemical properties, Model studies, Ecosystems, Adsorption, Toxicity, Leaching, Radioactive tracers, Bioaccumulation, Volatility.

The assessment of the magnitude of transfer of chemicals between air, water, soil, and biota and the resulting concentrations in the respective compartments are an indispensable prerequisite for the estimation of probable exposure, accumulation processes and toxicity for organisms including man. The determination of physicochemical data is the first step in elucidating the behavior of a chemical in the environment. Extensive laboratory work using model ecosystems as well as field tests are often needed to clarify relationships that exist in the natural environment. Tests for the assessment of the transfer of chemicals between soil and water include determinations of soil sorption coefficients and correlations with octanol-water partition coefficient, parachlor, dissociation constants and molecular connectivity indices, laboratory leaching, adsorption/desorption and runoff models, and field tests in lysimeters or open areas. Tests for assessment of the volatilization of chemicals from water to the air include determinations of physicochemical properties affecting the transfer, laboratory tests for Henry's law constants and volatility, and field tests for volatility in flowing channels, natural ponds, and over flooded fields. Tests for assessment of the transfer of chemicals from soil to the air include determinations of physicochemical properties affecting the transfer, laboratory tests for vapor pressure and laboratory and field tests for volatility. Laboratory and field tests for assessment of the transfer of chemicals from soils into higher plants and from plants to the air are also described. (See also W87-07233) (Geiger-PTT)
W87-07241

REGULATORY NEEDS FOR TESTS TO PREDICT THE BEHAVIOUR OF ENVIRONMENTAL CHEMICALS.
Umweltbundesamt, Berlin (Germany, F.R.).
IN: Appraisal of Tests to Predict the Environmental Behaviour of Chemicals, Scope 25. John Wiley and Sons, Chichester, England, 1985. p 333-349, 2 fig, 6 ref.

Descriptors: *Path of pollutants, *Testing procedures, *Fate of pollutants, *Standards, *Pollutant identification, *Legislation, International commissions, Legal aspects, Prediction, Toxicity, Hazardous materials, Toxins, Environmental policy.

The number and variety of chemicals involved in national and international control strategies make it necessary to develop and regulate internationally harmonized specific test methods wherever scientifically feasible. With regard to the design and selection of tests for evaluating health and environmental hazards of chemicals, several factors should be considered: predictive power, state of validation, reproducibility, ease of preformance, costs, automation, required level of skill, test animals, legal terminology and international harmonization of testing procedures. Research and development needs in the identification of chemicals, exposure, chemical fate, and effects of toxins are discussed. The present state of legislation regarding environmental chemicals for the European communities, the United States, Japan, Switzerland, and Sweden is reported. The present state of international harmonization of tests to predict the environmental behavior of chemicals is outlined for the European Economic Communities, the Organization of Economic Cooperation and Development, and the United Nations' International Programme of Chemical Safety. (See also W87-07233) (Geiger-PTT)
W87-07242

GROUNDWATER MONITORING SYSTEMS - ONLY AS GOOD AS THE WEAKEST LINK,
ERM-Midwest, Inc., Columbus, OH.
For primary bibliographic entry see Field 2F.
W87-07253

PROBLEMS IN ASSESSING ORGANICS CONTAMINATION IN GROUNDWATER,
Geraghty and Miller, Inc.
For primary bibliographic entry see Field 5A.
W87-07254

PRIVATE WELL SAMPLING IN VICINITY OF RE-SOLVE, INC., HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5A.
W87-07255

WATERWAY CONTAMINATION - AN ASSESSMENT OF CLEANUP PRIORITIES,
Malcolm Pirnie, Inc.
For primary bibliographic entry see Field 5G.
W87-07267

CASE HISTORY - REMEDIAL INVESTIGATION RE-SOLVE, INC. HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
J. A. Cassis, and D. Pedersen.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 307-317, 2 fig.

Descriptors: *Case studies, *Hazardous wastes, *Waste disposal, *Cleanup operations, *Copicut River, *Massachusetts, *Path of pollutants, *Groundwater pollution, Polychlorinated biphenyls, Wells, Plumes, Water pollution sources.

Re-Solve, Inc. operated a solvent reclamation facility for over 24 years on Hixville Road, terminating activities in 1980. Hazardous wastes (e.g., PCBs, inorganic and organic contaminants) have migrated off the site contaminating the nearby Copicut River, wetlands and the local groundwater. Based on CDM's remedial investigation, the contamination sources at the site are: (1) Four unlimited lagoons in the northern part of the site; (2) A former cooling pond area filled with sand; (3) An oil spreading area in the western portion of the site; and (4) Other contaminated soil areas ('hot spots'). These four sources were confirmed by the analysis obtained from the installation of 35 groundwater monitoring wells, surface water/sediment sampling, soil borings, test pit excavations and lagoon depth probing and analyses. However, the entire site remains a continuous source of contamination with the two major sources, the four unlined lagoons and an oil spreading area, contributing the majority of the contaminants to the environment. The Copicut River and Carol's Brook are presently acting as hydraulic barriers, confining the movement of the contaminant plume to within these two surface water bodies. The contaminant plume is moving in a southeastern direction toward the river, so that further migration of the contaminant plume in an easterly direction is not a concern. In addition, the private well water in the immediate vicinity of the site does not present a threat to public health at the present time. (See also W87-07243) (Lantz-PTT)
W87-07269

SITE SAFETY AND SAMPLING PLANS - THE FIRST STEP IN INVESTIGATING ABANDONED HAZARDOUS WASTE DISPOSAL SITES,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5E.
W87-07271

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY - TACOMA WATER SUPPLY WELLS COMMENCEMENT BAY AREA, TACOMA, WASHINGTON,
Black and Veatch, Kansas City, MO.
M. G. Snyder, and P. B. MacRoberts.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 335-352, 6 fig, 4 ref.

Descriptors: *Tacoma, *Water pollution sources, *Washington, *Commencement Bay, *Aquifers, *Groundwater pollution, *Path of pollutants, Monitoring wells, Geohydrology, Water supply, Cleanup operations, Permeability coefficient.

Contamination of groundwater drinking water supply wells in Tacoma, Washington was one segment of a hazardous waste contamination study in the Commencement Bay Area of Tacoma, Washington. Major components of the remedial investigation and preliminary feasibility study included: (1) installation of 13 groundwater monitoring wells ranging in depth from 58 to 199 ft; (2) installation of four soil borings to a depth of 30 ft; (3) collection and analysis of groundwater samples from the monitoring wells and existing public and private wells; (4) description of geologic and hydrogeologic characteristics in support of identification of the extent and magnitude of aquifer contamination; and (5) development and screening of remedial action alternatives to mitigate contamination of the affected water supply wells. The primary conclusions resulting from the remedial investigation are: (1) the aquifer which currently supplies water for residential and industrial use for the City of Tacoma is contaminated; (2) due to the expected proximity of the suspected primary source or sources of contamination in well 12A, contaminant concentrations will increase with time as the well is pumped; (3) contaminant transport is predominantly in the horizontal direction; (4) the migration of contaminants in the vertical direction is impeded by low permeability layers of silts, silty or clayey sands, and 'hardpan' which underlie the high permeability zone; (5) well 12A is screened at the bottom of what appears to be the contaminated high permeability zone and the upper portion of a deeper pervious zone; (6) the primary source or sources of contamination at wells 12A and 9A were not located during the remedial investigation; (7) the undisturbed pre-pumping or steady state groundwater gradient in the vicinity is in a west to east direction; (8) analysis of available information and data indicates that high concentrations of contaminants are likely to be present in the aquifer north and east of the study well; and (9) the boundaries of the contaminant plume are not well defined based upon data obtained during the investigation. (See also W87-07243) (Lantz-PTT)
W87-07272

SOIL INVESTIGATION AT THE RE-SOLVE, INC., HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
T. A. Pedersen.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 353-366, 5 fig, 4 tab, 4 ref.

Descriptors: *Path of pollutants, *Soil contamination, *Hazardous wastes, *Waste disposal, *Massachusetts, Fate of pollutants, Groundwater movement, Polychlorinated biphenyls, Chemical analysis.

Four soil test pits were excavated at the Re-Solve, Inc., hazardous waste site to ascertain the degree of soil contamination at the site and to evaluate the extent of and potential for continued migration of contaminants off-site. The test pits were located in areas where waste materials were known to have been deposited on the soil surface or to evaluate migration of contaminants off-site. The results of the investigations confirmed the presence of contaminants, especially PCBs, at elevated levels in the surficial soils on the site. Contaminants have migrated from the waste lagoons on the site to contiguous soils and disposal of oily wastes on the soil surface has led to the migration of contaminants vertically in the soil profile. The results of the soil investigations were utilized in conjunction with soil boring logs and groundwater analysis to develop a series of source control measures which are currently being implemented by the Massachusetts Department of Environmental Quality Engineering, USEPA and US Army Corps of Engineers. (See also W87-07243) (Lantz-PTT)
W87-07273

WATER QUALITY MONITORING RIVERS AND STREAMS: 1984.
Indiana State Board of Health, Indianapolis. Div. of Water Pollution Control.
For primary bibliographic entry see Field 7C.
W87-07301

RESERVOIR SYSTEM ANALYSIS FOR WATER QUALITY,
For primary bibliographic entry see Field 2H.
W87-07304

OIL-SPILL RISK ANALYSIS FOR THE SOUTH ATLANTIC LEASE SALE 90,
Minerals Management Service, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-07367

MARINE AND ESTUARINE GEOCHEMISTRY.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2L.
W87-07371

THERMAL DEGRADATION PRODUCTS OF NON-VOLATILE ORGANIC MATTER AS INDICATORS OF ANTHROPOGENIC INPUTS TO ESTUARINE AND COASTAL SEDIMENTS,
Battelle New England Marine Research Lab., Duxbury, MA.
A. G. Requejo, J. Brown, and P. D. Boehm.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 81-96, 5 fig, 1 tab, 20 ref.

Descriptors: *Water pollution sources, *Thermal degradation, *Organic matter, *Volatile organics, *Estuaries, *Boston Harbor, *Massachusetts Bay, *Cape Cod Bay, *Pollution identification, *Path of pollutants, Coastal sediments, Chemical analysis, Gas chromatography, Mass spectrometry, Organic compounds, Benzenes, Styrene.

Anthropogenic inputs to surficial sediments in Boston Harbor, Massachusetts Bay and Cape Cod Bay were evaluated using stepwise pyrolysis of sediments followed by capillary gas chromatographic and gas chromatography/mass spectrometric analyses of the volatile degradation products. A positive correlation was found between the ratio styrene/C2-benzenes in sediment pyrolysates and the distribution of several classes of trace organic pollutants (PCB, PAH and the fecal sterol coprostanol) determined by conventional extraction methods. This correlation suggests an anthropogenic origin for these pyrolysates. A consideration of various substances which might yield styrene as a pyrolysate indicates that thermal degradation of synthetic polymers present in the sediments is the most likely mechanism of origin. The highest correlations with the styrene/C2-benzenes pyrolysis ratio involved the sewage tracer coprostanol, suggesting that wastewater effluent discharges may be a source of styrene-generating substances to the sediments. The results demonstrate the potential of pyrolysis as an analytical tool in marine pollution studies. (See also W87-07371) (Author's abstract)
W87-07376

PARTITIONING OF PCBS IN MARINE SEDIMENTS,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
B. J. Brownawell, and J. W. Farrington.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 97-120, 7 fig, 4 tab, 42 ref.

Descriptors: *Model studies, *Path of pollutants, *Polychlorinated biphenyls, *Marine sediments, *New Bedford Harbor, *Massachusetts, Fate of pollutants, Interstitial water, Model studies, Colloids, Chemical analysis, Organic compounds.

Polychlorinated biphenyls (PCBs) are useful model compounds to study the physical-chemical processes which affect the biogeochemistry of hydrophobic organic compounds. In this study, two box cores from New Bedford Harbor, Massachusetts, were analyzed for PCBs. Measurements are reported for total PCBs and several individual chlorobiphenyls for both the sediments and interstitial waters. Concentrations of total PCBs were highly elevated in the pore waters and reached a maximum of 20.1 micrograms/L at the Outer Harbor site. Results from these two cores combined with predictions from laboratory experiments indicate that most of the PCBs measured in interstitial waters are actually sorbed to organic colloids. The partitioning of chlorobiphenyls between water column particulates and filtrate shows a greater importance of dissolved compounds due to lower concentrations or organic colloids. A simple three-phase equilibrium model involving colloids, dissolved phase, and chlorobiphenyls sorbed to particulate organic matter is presented to explain the observed partitioning. (See also W87-07371) (Author's abstract)
W87-07377

SILICONES IN ESTUARINE AND COASTAL MARINE SEDIMENTS,
Naval Research Lab., Washington, DC. Chemistry Div.

R. E. Pellenbarg.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 121-126, 4 fig, 1 tab, 8 ref.

Descriptors: *Silicones, *Estuaries, *Marine sediments, *Path of pollutants, *Potomac River, District of Columbia, Sediments, Organic compounds, Polyorganosiloxanes.

Polyorganosiloxanes (silicones) are synthetic, extremely inert surface active organic compounds widely used in consumer products. Silicones were measured in the filter cake, sludge, and aqueous effluent produced at the Blue Plains Wastewater Treatment Facility in Washington, D.C. (a major Point source in Potomac estuary, up to 95 ppm, dry wt/wt basis), in Potomac River sediments (0.5-3 ppm), sediments of the heavily impacted New York Bight (0-50 ppm), and in sediments of the Chesapeake Bay (0-30 ppm). These results indicate that silicones are useful tracers of anthropogenic impact on sediments. (See also W87-07371) (Author's abstract)
W87-07378

TIN METHYLATION IN SULFIDE BEARING SEDIMENTS,
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. C. Gilmour, J. H. Tuttle, and J. C. Means.
IN: Marine and Estuarine Geochemistry, Lewis Publishers, Chelsea, Michigan. 1985. p 239-258, 3 fig, 5 tab, 46 ref.

Descriptors: *Tin, *Methylation, *Marine sediments, *Sulfides, *Chesapeake Bay, *Path of pollutants, *Sulfur bacteria, Anaerobic conditions, Estuaries.

Metals in anaerobic sulfide rich sediments are often considered unavailable for biological transformation due to the extreme insolubility of metal sulfides. Sediment tin methylation rates are found to be the highest under anaerobic conditions. The potential for methylation of Sn was examined in anoxic, sulfidic Chesapeake Bay sediment slurries spiked with 50 mg/L SnCl4. Over 61 days, live slurries produced microgram/L levels of mono- (MMT) and dimethyltin (DMT), determined as their corresponding hydride derivatives by GCMS. Whole sediments incubated with inorganic tin also produced microgram/L quantities of MMT and DMT in 3 weeks, even at sulfide concentrations in excess of inorganic tin concentration. Production of MMT in sediments was significantly correlated with numbers of both sulfate reducing and sulfide oxidizing bacteria. Desulfovibria spp. isolated from the sediments were able to methylate Sn in culture medium at rates similar to whole sediment slurries. Sulfate reducing organisms seem to have a dominant role in sediment tin methylation, possibly allowing the mobilization of tin sulfides. Although the relative importance of tin transformation in sulfidic and nonsulfidic sediments is unknown, there is potential for production of highly toxic organotin species in sulfide bearing aquifers and in estuarine and marine sediments. (See also W87-07371) (Author's abstract)
W87-07383

GLOBAL INPUTS, CHARACTERISTICS, AND FATES OF OCEAN-DUMPED INDUSTRIAL AND SEWAGE WASTES: AN OVERVIEW,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5E.
W87-07397

SIMPLE MODELS OF WASTE DISPOSAL IN A GYRE CIRCULATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology and Physical Oceanography.
For primary bibliographic entry see Field 5E.
W87-07399

PHYSICAL OCEANOGRAPHY STUDIES RELATED TO WASTE DISPOSAL IN THE SEA,
Copenhagen Univ. (Denmark). Inst. of Physical Oceanography.
For primary bibliographic entry see Field 5E.
W87-07400

LONG-TERM MIXING PROCESSES IN SLOPEWATER,
Woods Hole Oceanographic Institution, MA.
G. T. Csanady.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p. 103-116, 5 fig, 1 tab, 22 ref.

Descriptors: *Mixing, *Path of pollutants, *Fate of pollutants, *Mixing, *Dilution, *Waste disposal, *Slope water, *New York Bight, *Ocean dumping, Gyres, Industrial wastes, Flow rates, Salinity.

The fate of industrial waste barged to the Deepwater Dumpsite-106 (DWD-106) in New York Bight can be followed in diffusion experiments for a maximum period of about three days only, after which the waste becomes too dilute and its advection by currents too erratic for successful detection. However, a natural tracer is available to demonstrate the principal mechanisms of long-term mixing in this area: the freshwater originating from land runoff. Potentially important transport processes for the freshwater runoff are advection by a large cyclonic gyre between the Gulf Stream and the North American continent, an upwelling-like circulation in the vertical plane, a random process of parcel separation at the shelf-edge front, and a similar random process of warm core ring shedding by the Gulf Stream. The random parcel and ring shedding processes are akin to mixing due to mechanical turbulence and are amenable to similar statistical treatment. The landward salt transport by the latter processes constitutes a large fraction of the total salt transport, which compensates for the freshwater flow. An estimate of the rate at which parcels of anomalous water break down in the slope water region can be reached by considering the balance of mean square salinity fluctuation. The estimated time scale of decay may be supposed to parameterize the long-term diffusion process of barged waste, after the latter has formed a cloud comparable in size to the typical parcels of anomalous water. This decay time scale is estimated to be of the order of five months, on the basis of historical data of mean square salinity fluctuations and the known rate of freshwater inflow. (See also W87-07396) (Author's abstract)
W87-07401

DISPERSION OF PARTICLES AFTER DISPOSAL OF INDUSTRIAL AND SEWAGE WASTES,
Woods Hole Oceanographic Institution, MA.
M. H. Orr, and L. Baxter.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 117-137, 8 fig, 22 ref. NOAA Grants 04-7-158-44054, NA 79AA-D-00030 and 04-8-M01-43; Naval Ocean Research and Development Activity Contract N0014-77-C-0196.

Descriptors: *Dispersion, *Measuring instruments, *Waste disposal, *Path of pollutants, *Industrial wastes, *Wastewater disposal, *New York Harbor, Acoustics, Water sampling, Particular matter, Backscattering, Particle size.

A high-frequency acoustic backscattering system has been used to study the dispersion of particulates released or formed during the disposal of industrial chemical wastes and sewage sludge at the Deepwater Dumpsite-106 (DWD-106) located 196 km southeast of New York Harbor, New York. The acoustic systems provide real-time data to guide chemical and biological sampling of contaminated and uncontaminated sections of the water column as particles associated with the waste plumes serve as waterborne tracers which can be acoustically tracked. In addition, the data sets can be used to determine the temporal variability of the particle vertical and horizontal distribution. The acoustic data have shown that the vertical and horizontal distribution of the particulates released at DWD-106 is seasonally dependent, reflecting both the temporal variability of the magnitude of density gradients associated with the seasonal mixed layer and the water mass variability of the area. In a qualitative sense, the acoustic backscattering technique is beneficial to an environmental impact monitoring experiment. However, one of the objectives of developing the technique has been to measure the horizontal and vertical dispersion coefficients of particle plumes. The quantitative analysis of the acoustic data has been limited by navigation inadequacies, the inability to measure vertical shear, the lack of knowledge concerning waste particle size distributions and densities (hence settling rates), and the influence of oceanic turbulence on the particle field. (See also W87-07396) (Author's abstract)
W87-07402

ACID-IRON DISPOSAL EXPERIMENTS IN SUMMER AND WINTER AT DEEPWATER DUMPSITE-106,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
P. Mukherji, and D. R. Kester.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 141-155, 3 fig, 8 tab, 29 ref. NOAA Grant 04-8-M01-39.

Descriptors: *Waste disposal, *Heavy metals, *Diffusion, *Dispersion, *Model studies, *Ocean dumping, *Acids, *Seasonal variation, *Iron, *Path of pollutants, Industrial wastes, Copper, Cadmium, Lead, Spectrophotometry.

The concentrations and distributions of total and particulate iron, copper, cadmium, and lead associated with acid-iron wastes were measured at Deepwater Dumpsite-106 (DWD-106) during July 1977 and February 1978 to study the fate of these wastes in the ocean after dumping. Concentrations were measured by obtaining discrete samples which were analyzed by atomic absorption spectrophotometry. In July, the waste material was confined to the upper 20 m of the water column and within the mixed layer for a period of up to 27 hr. The waste mixed to greater depths during February when the seasonal thermocline was absent and the permanent pycnocline was below 100 m. Total iron was used as a tracer to follow the waste plume. The results were related to two models for plume dispersion by diffusion processes during the initial 5 hr after the dump. A model based on a constant diffusion velocity (as opposed to a constant eddy diffusivity) fit the data best, yielding a diffusion velocity of 1.1 cm/sec. (See W87-07396) (Author's abstract)
W87-07403

AUTOMATED IRON MEASUREMENTS AFTER ACID-IRON WASTE DISPOSAL,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W87-07404

VOLATILE ORGANIC WASTES AT THE PUERTO RICO DUMPSITE,
Texas A and M Univ., College Station. Dept. of Oceanography.
J. M. Brooks, D. A. Wiesenburg, G. Bodennec, and T. C. Sauer.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 171-198, 13 fig, 4 tab, 12 ref. NOAA Grant 04-8-M01-55.

Descriptors: *Volatile organics, *Industrial wastes, *Puerto Rico, *Ocean dumping, *Path of pollutants, Dichloromethane, Butanol, Toluene, Dimethylaniline, Chloroform, Benzene, Dichloroethane, Xylene.

Waste materials from pharmaceutical production are discharged into the ocean at a dumpsite which is located approximately 74 km north of Arecibo, Puerto Rico, overlying 6000-8000 m of water. Volatile organic material constitutes the major nonaqueous fraction of the approximately 3.0 times 10 to the 8th kg/yr (wet wt) discharged into the

surface waters at this site. Three samples of composite waste discharged at different times indicate significant changes in the waste composition over a two-year period (1978-1980). Waste samples obtained in February 1978 consisted mainly of dichloromethane, butanol, toluene, and dimethylaniline. These compounds were measured in the discharged waste plume and were also found in the dumpsite area three days after dumping. Dimethylaniline was observed in background measurements at the dumpsite at a concentration of approximately 100 ng/L. Background concentrations of dichloroethane, benzene, chloroform, toluene, ethylbenzene, and xylene at the dumpsite area were between 5 and 30 ng/L. These concentrations are six orders of magnitude less than 1-10 mg/L observed in the plume sampled 30 min after the waste was dumped. Composite waste samples taken in October 1979 indicated significant compositional differences from the February 1978 samples. The majority of the aromatic compounds (toluene, xylenes, C3-benzenes, and C4-benzenes) with no significant amounts of alcohols or substituted anilines being observed. The volatile hydrocarbon 'fingerprint' in the waste plume, in the surface waters north of Puerto Rico, and in the 1979 waste consisted mainly of these alkyl benzenes. A volatile organic 'fingerprint' from the discharged waste was observed over a 23,000 sq km area north of Puerto Rico at concentrations ranging from 0.1 to 8 micrograms/L. The observed 'fingerprint' suggested that volatile organics from previous dumps still remained in the area. Samples taken from depths down to 200 m indicated that the dumpsite waters had penetrated the thermocline. (See also W87-07396) (Author's abstract)
W87-07405

IN-CLOUD PROCESSES FOR SULFUR TRANSFORMATION AND SCAVENGING,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W87-07417

MASS BALANCE MODELING OF HEAVY METALS IN SAGINAW BAY, LAKE HURON,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
D. M. Dolan, and V. J. Bierman.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-232701. Price codes: A02 in paper copy, and A01 in microfiche. EPA Report EPA-600/J-82-435, 1982. 19 p 14 fig, 5 tab, 28 ref.

Descriptors: *Path of pollutants, *Sedimentation, *Saginaw Bay, *Lake Huron, *Michigan, *Heavy metals, Zinc, Lead, Cadmium, Copper, Suspended solids, Model studies, Water column.

During the period 1976-1978, a study of hazardous materials in Saginaw Bay was conducted. This study included the fate and distribution of cadmium, copper, lead, and zinc in the bay. A spatially segmented, dynamic mass balance model was developed to describe concentrations of metals and suspended solids in the water column and in the sediments. A wind-driven resuspension mechanism was used to describe the sediment-water interactions. The distribution of metals in the water column was determined by equilibrium partitioning between the ambient suspended solids and the dissolved phase. Model output was calibrated to field data for the principal variables. Independent validation was obtained by comparing partition coefficients from the calibration to those calculated directly from the field observations. It was found that suspended solids were important in controlling the water column concentrations of the metals. The degree of control was a function of the partition coefficient between the metal and the solids, and the concentration of the solids. Adsorption of the metals to the solids was found to result in decreases to metals concentrations due to net sedimentation, as well as increases due to wind-driven resuspension. On an annual average basis, the net flux of the particulate components of all four metals was from the water column to the sediment except for copper in 1977. (Author's abstract)
W87-07418

TRANSVERSE MIXING IN MEANDERING LABORATORY CHANNELS WITH RECTANGULAR AND NATURALLY VARYING CROSS SECTIONS,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 2E.
W87-07420

TEST OF A NON-UNIFORM MIXING MODEL FOR TRANSFER OF HERBICIDES TO SURFACE RUNOFF,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
G. C. Heathman, L. R. Ahuja, and J. L. Baker.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 450-455, 461, March-April 1986. 6 fig, 2 tab, 31 ref.

Descriptors: *Model studies, *Path of pollutants, *Herbicides, *Surface runoff, *Nutrients, Field tests, Residue cover, Mixing, Rainfall, Infiltration, Adsorption.

The applicability of a non-uniform mixing model to describe the transfer to runoff of four surface-applied herbicides (atrazine, alachlor, propachlor, and cyanazine) and three nutrients (NH_4, NO_3, and PO_4) was tested using field plot data for four levels of residue cover (0, 375, 750, and 1500 kg/ha). The model incorporates the varying degree of mixing with depth between rainwater and soil during the chemical transfer process, as well as the effects of infiltration on chemical movement into the soil before and after runoff begins. Starting from the time of runoff initiation, it is assumed that the degree of mixing between rainfall and soil solution, beta, decreases exponentially with soil depth so that beta = exp (-bz), where b is a constant and z is the soil depth. The adsorption-desorption process is represented by a proportional relationship, C sub s = alpha C, where C sub s is the concentration of chemical in the adsorbed phase on soil particles (g/mL) and alpha is a constant. Numerical computations are made in small intervals of soil depth and time. In all cases, model calculations compared well with measured chemical concentration-time curves. The structure of the model for the variable degree of mixing with depth, the partitioning equation for adsorbed and solution phases, and the downward displacement of the chemical by infiltration seems to reasonably represent reality. The alpha parameter, for a particular chemical, was generally constant among replicates of a given residue level. The b parameter varied some between replicates apparently due to spatial variations of surface conditions. Values of alpha and b, in general increased as residual level increased. The increase in alpha indicates that the residue cover on the soil surface shields some of the chemical underneath, which is, in effect, similar to increasing the adsorption of the chemical. The increasing values of b indicate that increased residue cover decreased the depth of soil mixing with rainwater. (Author's abstract)
W87-07450

SPILLWAY DESIGN AFFECTS RESERVOIR WATER QUALITY,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
For primary bibliographic entry see Field 8A.
W87-07452

CHANGES IN THE DISTRIBUTION PATTERNS OF TRACE METALS IN SEDIMENTS OF THE MERSEY ESTUARY IN THE LAST DECADE (1974-83),
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
D. Taylor.
The Science of the Total Environment STENDL, Vol. 49, p 257-295, March 1986. 21 fig, 6 tab, 32 ref.

Descriptors: *Trace metals, *Sediments, *Mersey Estuary, *Estuaries, *Path of pollutants, *Heavy metals, Mercury, Copper, Chromium, Water pollution effect, Monitoring, Spatial variation, Temporal variation, Metals, Surveys.

A survey of the trace metal distribution in the sediments of Liverpool Bay, and the Dee and Mersey estuaries in 1972-74 was followed by a series of regular monitoring surveys in the Mersey estuary during the last 10 years. Over 15000 individual observations have been recorded, including measurements of the trace metal content (cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel and zinc), organic carbon content and particle size distribution. In parallel with the physical and chemical measurements, a limited biological sampling programm was also carried out. The sediments of the Mercury estuary contain elevated concentrations of some trace metals, in particular Cr, Cu, and Hg, compared to an uncontaminated control area. There is high correlation between the trace metal content of the sediment and the content of both organic carbon and silt. As a consequence, the distribution patterns of the trace metals within the sediment of the estuary reflect the particle size distribution and not the position of the input source. Analysis of core samples suggests that in the consolidated salt marches elevated metal concentrations are restricted to the upper 2 m of the sediment. The Hg and Cu concentrations in the estuary sediments are slowly declining, while the reverse is true of the Cr content. From the limited biological survey undertaken it is clear that the estuary is far from devoid of life. No evidence was found that the benthic infauna were being affected by the concentrations of trace metals in the estuary sediments. (Peters-PTT)
W87-07466

OCCURRENCE AND SPECIATION OF ORGANOMETALLIC COMPOUNDS IN FRESHWATER SYSTEMS,
Canada Centre for Inland Waters, Burlington (Ontario).
Y. K. Chau.
The Science of the Total Environment STENDL, Vol. 49, p 305-323, March 1986. 2 fig, 3 tab, 91 ref.

Descriptors: *Analytical methods, *Organometallic compounds, *Freshwater, *Path of pollutants, *Heavy metals, *Chromatography, *Spectrometry, Spectral analysis, Sample preparation, Speciation, Limnology.

Organometals and organometalloids have been found in environmental samples as a result of their extensive usage and biotic and abiotic methylation processes. Alkyllead and organotin compounds are the most widely used organometals. In connection with studies of organometallic speciation, highly sensitive, and specific analytical techniques were developed using combination analytical systems. At present, combination systems consisting of a separation technique coupled with an element-specific, atomic spectrometric detector are most satisfactory. A variety of atomic spectrometric detectors were used in combination with gas chromatography and liquid chromatography. (Author's abstract)
W87-07468

EVALUATION OF DATA REQUIREMENTS FOR GROUNDWATER CONTAMINANT TRANSPORT MODELING,
Washington Univ., Seattle. Dept. of Civil Engineering.
W.-S. Chu, E. W. Strecker, and D. P. Lettenmaier.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 408-424, March 1987. 10 fig, 7 tab, 35 ref. Bu Rec Grant 4-FG-93-00010 and Geological Survey Grant 14-08-0001-G-1059.

Descriptors: *Model studies, *Data requirements, *Groundwater pollution, *Path of pollutants, Algorithms, Aquifers, Transport, Prediction, Groundwater, Estimating, Plumes, Simulation.

Groundwater flow and contaminant transport models have been widely used for planning and design purposes in the past decade. Two of the most significant limitations for application of these models are data availability and parameter estimation. By use of a parameter identification algorithm and synthesized data, it is possible to isolate the effects of data availability and data uncertainty.

This approach was implemented using the U.S. Geological Survey's method of characteristics (USGS-MOC) model for a hypothetical aquifer. A parameter identification scheme attached to the USGS-MOC model was used to determine unknown transmissivities and dispersivities. The study results showed that the predictive ability of the USGS-MOC model (and, by implication, similar models) is limited unless relatively extensive and good quality data are available. For the example tested, it was found that extending the length of the observation series was more effective in improving parameter estimates and resolution of the contaminant plume prediction than adding observations wells. Further, when the boundary conditions were known, the contaminant predictions were much more sensitive to accurate estimation of transmissivity than to the estimation of dispersivities. The numerical results also showed that after a relatively short simulation period (less than 4 years), predicted contaminant concentrations could be significantly in error. This suggests the importance of integrating uncertainty analysis into the prediction of long-term contaminant transport. (Author's abstract)
W87-07472

DIRECT COMPARISON OF KINETIC AND LOCAL EQUILIBRIUM FORMULATIONS FOR SOLUTE TRANSPORT AFFECTED BY SURFACE REACTIONS,
Geological Survey, Menlo Park, CA.
J. M. Bahr, and J. Rubin.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 438-452, March 1987. 7 fig, 5 tab, 26 ref, append.

Descriptors: *Model studies, *Solute transport, *Porous media, *Kinetics, *Path of pollutants, *Hazardous wastes, *Groundwater pollution, Surface reaction, Comparison studies, Groundwater movement, Aquifer contamination, Sorption, Ion exchange.

Modeling transport of reacting solutes in porous media often requires a choice between models based on the local equilibrium assumption (LEA) and models involving reaction kinetics. Direct comparison of the mathematical formulations for these two types of transport models can aid in this choice. For cases of transport affected by surface reaction, such a comparison is made possible by a new derivation procedure. This procedure yields a kinetics-based formulation that is the sum of the LEA formulation and one or more kinetically influenced terms. The dimensionless form of the new kinetics-based formulation facilitates identification of critical parameter groupings which control the approach to transport behavior consistent with LEA model predictions. Results of numerical experiments demonstrate that criteria for LEA applicability can be expressed conveniently in terms of these parameter groupings. The derivation procedure is demonstrated for examples of surface reactions including first-order reversible sorption, Langmuir-type kinetics and binary, homovalent ion exchange. (Author's abstract)
W87-07474

STOCHASTIC THEORY OF FIELD-SCALE FICKIAN DISPERSION IN ANISOTROPIC POROUS MEDIA,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, C. L. Winter, and C. M. Newman.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 453-466, March 1987. 6 fig, 38 ref, append.
NRC Contract NRC-04-78-275.

Descriptors: *Fickian dispersion, *Porous media, *Permeability coefficients, *Dispersion, *Dilution, *Path of pollutants, *Groundwater movement, *Hydraulic conductivity, *Dispersivity, Eigenvalues, Velocity, Convection, Anisotropy.

A three-dimensional theory is described for field-scale Fickian dispersion in anisotropic porous media due to the spatial variability of hydraulic conductivities. It leads to results which differ in important ways from earlier theoretical conclusions about dispersion in anisotropic media. The dispersion tensor D is expressed as the sum of a local component d and a field-scale component Delta. The local component is assumed to be independent of velocity its principal terms are taken to act parallel and normal to the mean velocity vector mu. The field-scale component is written as alpha mu, where alpha is a dispersivity tensor and mu = mu. It is shown that at large peclet numbers P, the dispersivity tensor reduces to a single principal component parallel to the mean velocity, regardless of how mu is oriented. This result, valid for arbitrary covariance functions of log-hydraulic conductivity, differs from that of L. W. Gelhar and C. L. Axness , according to whom the asymptotic dispersivity tensor may possess more than one nonzero eigen value. They calculate the direction of the largest principal dispersivity to be offset from the mean velocity toward the direction of least spatial correlation. It is shown that this principal dispersivity is offset in the opposite direction at small and intermediate Peclet numbers but rotates toward the mean velocity as P increases. The largest eigen value is constant and dominated by field-scale velocity fluctuations at large P values. The other two eigen values diminish asymptotically in proportion to 1/P and are controlled by d as well as by field-scale differential convection. It is shown that at low P values all three principal dispersivities are proportional to P and thus Delta is proportional to mu squared. When the mean velocity is inclined to the axes of anisotropy, the eigen values of Delta are neither parallel nor normal to mu. However, since D is dominated by d at small Peclet numbers, the principal dispersion coefficients are asymptotically parallel and normal to the mean velocity just like when P is large; their maximum deviation from these directions occurs at intermediate P values. (Author's abstract)
W87-07475

CHANNEL MODEL OF FLOW THROUGH FRACTURED MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
Y. W. Tsang, and C. F. Tsang.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 467-479, March 1987. 15 fig, 36 ref.

Descriptors: *Model studies, *Fractured media, *Flow, *Solute transport, *Path of pollutants, *Nuclear wastes, *Radioactive wastes, *Channels, *Tracers, *Groundwater movement, Apertures, Breakthrough, Calibrations, Prediction, Stress, Reviews.

On the basis of a review of recent theoretical and experimental studies of flow through fractured rocks, the fluid flow and solute transport in a tight fractured medium in terms of flow through channels of variable aperture were studied. The channels are characterized by an aperture density distribution and a spatial correlation length. Aperture profiles along the channels are statistically generated and compared to laboratory measurements of fracture surfaces. Calculated tracer transport between two points in the fractured media is by way of a number of such channels. Tracer breakthrough curves display features that correspond well with recent data which lend support to the validity of the model. Calculated pressure profiles along the channels suggest possible measurements that may be useful in identifying the geometrical characteristics of the channels. Finally, predictions were made for tracer breakthrough curves in the case of single fractures under various degrees of normal stress. These suggest possible laboratory experiments which may be performed to validate this conceptual model. (Author's abstract)
W87-07476

LAGRANGIAN MODEL OF NITROGEN KINETICS IN THE CHATTAHOOCHEE RIVER,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W87-07491

TREATMENT REQUIREMENTS FOR ACID DRAINAGE FROM COAL STORAGE HEAPS,
SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5G.
W87-07493

AEROSOLS IN POLLUTED VERSUS NON-POLLUTED AIR MASSES: LONG-RANGE TRANSPORT AND EFFECTS ON CLOUDS,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W87-07508

CALCULATION OF FLOW AND POLLUTANT DISPERSION IN MEANDERING CHANNELS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
A. O. Demuren, and W. Rodi.
Journal of Fluid Mechanics JFLSA7, Vol. 172, p 63-92, November 1986. 13 fig, 1 tab, 57 ref.

Descriptors: *Meanders, *Channel flow, *Dispersion, *Path of pollutants, *Mathematical models, *Momentum equation, *Flow characteristics, *Model studies, Channels, Flow, Mathematical analysis, Model testing, Turbulent flow, Eddies, Water currents, Fluid mechanics, Stress.

A mathematical model for flow and pollutant spreading in meandering channels is presented which takes full account of the three-dimensionality of the flow and pollutant concentration fields. This model is based on the solution of the momentum equations governing the flow in the lateral, vertical, and longitudinal directions with a three-dimensional numerical procedure together with the continuity equation. Calculation of the turbulent stresses appearing in the momentum equations takes streamline curvature effects into account. The pollutant concentration field is subsequently obtained from a solution to its transport equation. The model is tested in three different meander situations for which velocity and concentration measurements are available from the literature; detailed comparisons of the velocity and concentration fields show generally good agreement. The effect of streamline curvature on the turbulent mass fluxes was found to be important only in the narrow channel with a smooth bed. Bed-generated turbulence appears to overrule this in the other two cases of a wide channel with a smooth bed and a narrow channel with a rough bed. The flow patterns show the presence of a single large eddy at most cross-sections in these cases, whereas the predictions indicate the presence of usually more than one eddy in the former case. (Author's abstract)
W87-07548

AGRICULTURAL CHEMICALS AND HEAVY METALS IN UPLAND SOILS AND VALLEY ALLUVIUMS OF THE LITTLE WASHITA RIVER BASIN,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
S. J. Smith, J. R. McHenry, R. G. Menzel, and N. H. Welch.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 5, p 333-336, September-October 1986. 3 fig, 2 tab, 12 ref.

Descriptors: *Agricultural chemicals, *Heavy metals, *Soil types, *Valleys, *Alluvium, *Little Washita River Basin, *Path of pollutants, *Oklahoma, Sediments, Nutrients, Agricultural watersheds, Acidity, Pesticide residues, Soil properties, Particle size, Sedimentation, Fallout, Water pollution sources, Nutrient removal, Sediment sorting, Conservation, Soil conservation.

Because of concern about agricultural chemicals and heavy metal accumulation in valley alluvium within a large agricultural river basin, about 54,000 hectares of alluvial cross-section deposits in the Little Washita River Basin (southeastern Oklahoma) were sampled and compared to associated upland soil materials. Parameters measured included plant nutrients (N, P, K), soil reaction (pH), pesticides (organochlorides, organophosphates, and phenoxys), heavy metals (As, Cd, Pb, Th, and U), particle-size distribution, and fallout Cs-137 (to

estimate sediment deposition). Plant nutrient contents (except for K) tended to be lower in the alluvial deposits than in the soils. Differences in pH were minor. No problems with pesticide residues were evident. The low and/or uniform heavy metal contents indicated no lingering, deleterious impact from mining or industrial activities. Particle size and Cs-137 data indicated a preferential sorting and deposition of sediment materials, with the fines moving farther downstream. Generally, results indicated a decreasing removal of plant nutrients and other chemicals from the upland soils during a recent five-year period with improved soil conservation practices. (Author's abstract)
W87-07562

BIOLOGICAL HALF-LIFE, ORGAN DISTRIBUTION AND EXCRETION OF 125I-LABELLED TOXIC PEPTIDE FROM THE BLUE-GREEN ALGA MICROCYSTIS AERUGINOSA,
New England Univ., Armidale (Australia). Dept. of Biochemistry, Microbiology and Nutrition.
I. R. Falconer, T. Buckley, and M. T. C. Runnegar.
Australian Journal of Biological Sciences AJBSAM, Vol. 39, No. 1, p 17-21, 1986. 1 fig, 2 tab, 13 ref.

Descriptors: *Algal toxins, *Peptides, *Cyanophyta, *Bioaccumulation, *Tissue analysis, *Microcystis, *Isotopic tracers, Toxins, Algae, Accumulation, Water pollution, Water pollution effects, Public health, Tracers, Blood, Liver, Kidneys, Urine, Excretion, Lakes.

Microcystis aeruginosa, a bloom-forming cyanobacterium common in fresh-water lakes, contains a potent hepatotoxin which, when purified, has been shown to be a heptapeptide of molecular weight 1019. The toxin was iodinated with 125I using the lactoperoxidase method. The labelled toxin was administered intravenously to adult female rats, and the half-life and organ distribution measured. The blood half-life after redistribution into extracellular pools was 42 min. The liver and kidneys showed accumulation of 21.7 + or - 1.1 and 5.6 + or - 0.2% of the dose, respectively, after 30 min. Little accumulation was observed in other organs and tissues. Small intestinal contents and urine contained 9.4 + or - 6.1 and 2.9 + or - 1.2% of the dose, respectively, after 120 min. It was concluded that the liver is the main target organ for both accumulation and excretion of the toxin. (Author's abstract)
W87-07567

QUANTITATIVE STUDY OF THE RETENTION OF RADIOACTIVELY LABELED E. COLI BY THE FRESHWATER SPONGE EPHYDATIA FLUVIATILIS,
Universite Libre de Bruxelles (Belgium). Lab. de Biologie Animale et Cellulaire.
P. Willenz, B. Vray, M.-P. Maillard, and G. Van de Vyver.
Physiological Zoology PHZOA9, Vol. 59, No. 5, p 495-504, September-October, 1986. 8 fig, 65 ref.

Descriptors: *Bioaccumulation, *Radioactive tracers, *Eschirichia coli, *Ephydatia, *Retention, *Particulate matter, *Sponges, Bacteria, Tracers, Ecology, Aquatic animals, Aquatic bacteria, Aquatic life, Aquatic habitats, Aquatic environment, Habitats, Environment, Food habits.

Young Ephydatia fluviatilis raised in vitro were provided with E. coli grown in the presence of 3H-labeled thymidine to quantify the amount of bacteria retained by sponges. The maximal retention capacity was reached after 15-24 hours and was followed by a loss of radioactivity at a steady rate. The nonspecific adhesion of bacteria to the substratum remained close to 10% for 15 hours and increased to as much as 43% by 24-48 hours. Sponges provided repeatedly with bacteria showed a higher retention capacity, suggesting the efficiency of the bacterial nutrition. Transmission electron microscopy and scanning electron microscopy showed that, after a preliminary adhesion to the choanocytes and exopinacocytes, bacteria were engulfed in individual phagosomes, which later fused together. This quantitative method should prove useful for further studies of the retention of any particulate matter by sponges. (Author's abstract)
W87-07568

CHEMICAL RESPONSE OF SOIL LEACHATE TO ALTERNATIVE APPROACHES TO EXPERIMENTAL ACIDIFICATION,
Maine Univ. at Orono. Dept. of Plant and Soil Sciences.
I. J. Fernandez, and P. A. Kosian.
Communications in Soil Science and Plant Analysis CSOSA2, Vol. 17, No. 9, p 953-973, 1986. 1 fig, 5 tab, 14 ref. EPA Contract CR812093010.

Descriptors: *Leachates, *Soil solution, *Acidification, *Acidic soils, *Simulated rainfall, *Model testing, *Microcosm studies, *Acid rain, *Soil chemistry, Soil types, Profiles, Soil profiles, Model studies, Rainfall, Forest soils, Computer models, Sulfur, Acidity, Hydrogen ion concentration.

One approach to evaluating computer models that predict terrestrial-aquatic ecosystem response to acid deposition is the experimental acidification of soils. Using a soil microcosm experimental approach, comparisons between simulated acid rain (i.e., dilute H_2SO_4), dry NH_4NO_3, and prilled reduced S were made for suitability for large-scale field experiments. Soil microcosms consisting of reconstructed soil profiles received a background simulated throughfall dosing over a six-month period. Results indicated that simulated throughfall, applied at twice the ambient rate, acidified soil leachates approximately 0.5 pH units over the treatment period. There was also an apparent release of base cations as well as Fe and Al. Very little of the prilled S dissolved, and the simulated acid rain treatment did not have significant effects on leachate chemistry. This study supports the notion that N amendments should also be considered as useful experimental acidification treatments. It is suggested that future concerns for aquatic acidification effects may very well focus on the rising rate of N emissions and deposition. (Author's abstract)
W87-07572

MODELLING OIL MOVEMENTS FROM THE KURDISTAN SPILL IN CABOT STRAIT, NOVA SCOTIA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
R. W. Trites, D. J. Lawrence, and J. H. Vandermeulen.
Atmosphere-Ocean ATOCDA, Vol. 24, No. 3, p 253-264, September 1986. 5 fig, 1 tab, 25 ref.

Descriptors: *Nova Scotia, *Model studies, *Oil spills, *Cabot Strait, *Path of pollutants, *Water pollution, *Marine environment, Environment, Oil, Straits, Ice, Wind, Weather, Oceanography, Water currents, Prediction, Error analysis, Mathematical analysis.

The spill of Bunker-C oil from the tanker Kurdistan into the waters and ice of the Cabot Strait in March 1979 provided an opportunity to develop and test a relatively simple oil movement and spread model. Model development was facilitated by wind and air pressure observations throughout the period, archived oceanographic and meteorological data, and a better than usual oil sighting data base in the weeks following the accident. A model that provided a good fit with the oil sightings over a 30-day period following the spill utilizes a vector addition of the residual circulation and 3% of the wind, combined with radially symmetric lateral diffusion determined graphically using rate constants taken from the published literature. An error estimate for the modelled movement and spread of the oil is also presented. Although a small quantity of oil became mixed with the ice moving out of the Gulf of St. Lawrence, the bulk remained in open water. Over the 30-day period following the spill, four wind events were found to be of paramount importance in determining the oil movement, with residual circulation playing only a secondary role. (Author's abstract)
W87-07592

NEUTRALIZATION OF ACIDIC BROOK-WATER USING A SHELL-SAND FILTER OR SEA-WATER: EFFECTS ON EGGS, ALEVINS AND SMOLTS OF SALMONIDS,
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
For primary bibliographic entry see Field 5G.
W87-07593

5C. Effects Of Pollution

WATER-SALINITY-PRODUCTION FUNCTIONS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3C.
W87-06668

EFFECTS OF SUSPENDED SOLIDS ON THE ACUTE TOXICITY OF ZINC TO DAPHNIA MAGNA AND PIMEPHALES PROMELAS,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
W. S. Hall, K. L. Dickson, F. Y. Saleh, J. H. Rodgers, and D. Wilcox.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 913-920, December 1986. 7 fig, 3 tab, 22 ref.

Descriptors: *Water pollution effects, *Toxicity, *Daphnia, *Suspended solids, *Minnows, Sorption, Water chemistry, Alkalinity, Water quality standards.

Current procedures for setting site-specific water quality criteria consider abiotic and biotic factors. Suspended solids were shown to be important in reducing zinc toxicity to water column organisms. At zinc concentrations of 1 mg/L in solutions with $<$ 100 mg/L of all suspended solids tested, zinc toxicity to D. magna was reduced. Sorption of zinc to suspended solids and/or changes in water chemistry due to the addition of suspended solids appear to have been the factors causing reductions in zinc toxicity to D. magna. Only suspended solids levels of 483-734 mg/L of a type that increased total alkalinity, total hardness, and total dissolved carbon clearly reduced the toxicity of 20 mg/L zinc to P. promelas. The toxic form of zinc to these organisms appears to reside in the aqueous phase. Characteristics of suspended solids did not influence the partition coefficient of zinc in sorption experiments of $<$ or $=$ 96 h. The slopes of dose-response curves proved to be useful for assessing the potential of an organism to respond to changes in aqueous phase zinc concentrations, and may be a useful biological parameter when considering site-specific water quality criteria for chemicals. (Author's abstract)
W87-06684

MARBLE WEATHERING AND AIR POLLUTION IN PHILADELPHIA,
Delaware Univ., Newark. Dept. of Geography.
J. J. Feddema, and T. C. Meierding.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 143-157, January 1987. 14 fig, 2 tab, 38 ref.

Descriptors: *Philadelphia, *Air pollution effects, *Marble, *Weathering, *Tombstones, *Acid rain, Urban areas, Sulfur dioxide, Scavenging, Exfoliation, Air quality.

Maps of damage to marble tombstones in the urban region of Philadelphia demonstrate a close spatial correspondence with airborne pollutant concentrations. Mean recession rates on upper tombstone faces are an order of magnitude greater (3.5 mm/(100a)) in the center of the city than they are 20 km away in the suburbs and countryside ($<$0.5 mm/(100a)). Not only are more pollutants emitted in the city, but they are also concentrated in the city center by centripetal air movement into the urban heat island. Gaseous SO_2 appears to be the most damaging pollutant, as is shown by the presence of gypsum in urban stones. Although rainfall is important in removing sulfate reaction products, anthropogenically-induced acid rain has only a minor role in marble deterioration. High urban SO_2 concentrations cause sufficient gypsum accu-

mulation within the stones to exfoliate the durable surface layer. Old photos of tombstones in central Philadelphia cemeteries show that exfoliation greatly accelerated between 1930 and 1960, concurrent with increases in SO2 levels. Recent improvements in air quality are likely to have slowed stone deterioration. (Author's abstract)
W87-06746

MICROBIOLOGICAL ASPECTS OF FISH GROWN IN TREATED WASTEWATER,
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
N. Buras, L. Duek, S. Niv, B. Hepher, and E. Sandbank.
Water Research WATRAG, Vol. 21, No. 1, p 1-10, January 1987. 3 fig, 11 tab, 34 ref.

Descriptors: *Water pollution effects, *Impaired water use, *Treated wastewater, *Fish physiology, *Carp, Population exposure, Bacteria, Tissue analysis, Ponds, Growth, Coliforms, Bioindicators, Escherichia coli.

Tilapia, common carp and silver carp were reared in treated domestic wastewater. The most sensitive to this environment was the silver carp, followed by common carp and tilapia. In healthy clean fish, bacteria were not found in the blood or the muscles. They were present in small numbers in various organs and in concentrations of 1000000 - 10000000/g in the digestive tract content. In fish exposed to treated wastewater for the entire growing period, bacteria were found in the muscles. The number of bacteria recovered from various organs ranged between 10000 - 1000000/g and their concentration in the digestive tract content was 10 to the 8th power to 10 to the 9th power/g. The number of bacteria in the pond water determined the presence and concentration of bacteria in the fish. The number of bacteria that caused their appearance in the muscles of fish has been named the 'threshold concentration'. Considering the public health aspects, fish can be reared in treated wastewater provided the bacteriological quality of the water is compatible with the 'threshold concentration' levels of the fish grown in the ponds. The suitability of E. coli (fecal coliform bacteria) as indicators for the bacteriological quality of fish grown in wastewater-fed ponds is examined. (Author's abstract)
W87-06748

EUTROPHICATION OF A COASTAL DUNE AREA BY ARTIFICIAL INFILTRATION,
Leiden Rijksuniversiteit (Netherlands). Dept. of Environmental Biology.
H. W. J. van Dijk, and W. T. de Groot.
Water Research WATRAG, Vol. 21, No. 1, p 11-18, January 1987. 8 fig, 14 ref.

Descriptors: *Dunes, *Coastal dunes, *Netherlands, *Eutrophication, *Artificial infiltration, *Infiltration, *Groundwater, *Aquifers, Nutrients, Aquatic plants, Tracers, Dispersion, Desorption.

In their natural state, the Dutch coastal dunes are an oligotrophic to mesotrophic environment. Orthophosphate concentrations, for instance, are typically below 0.1 mg PO4/L in the phreatic ground water. This low nutrient profile is overlain by an intricate pattern of gradients of other abiotic factors, giving rise to an extremely diverse vegetation, among which many rare plant species can be found. In the Dutch coastal dunes, an originally nutrient-poor biotope, eutropic river water is infiltrated for public water supply purposes. Changes in the vegetation reflect this additional supply of nutrients, up to distances of hundreds of metres from infiltration ponds. The penetration of potassium, nitrate and phosphate into the upper aquifer was analysed. Tracers were used to separate non-conservative processes from physical transport, e.g. hydrodynamic macro-dispersion. Potassium was shown to spread far through the dune ecosystem. Desorption of phosphate was observed in the vicinity of infiltration ponds. Nitrogen concentrations tend to be dominated by local biological sources. (Alexander-PTT)
W87-06749

APPLICATION OF A STRATEGY TO REDUCE ENTRAINMENT MORTALITY,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
A. E. Steen, and J. R. Schubel.
Journal of Environmental Management JEVMAW, Vol. 23, No. 3, p 215-228, October 1986. 6 fig, 2 tab, 24 ref.

Descriptors: *Entrainment, *Mortality, *Temperature effects, *Water temperature, *Powerplants, *Cooling water, *Thermal stress, *Thermal pollution effects, Environmental protection, Resources management, Electric powerplants, Potomac River, Larvae, Temperature, Lethal limit, Fish, Regression analysis.

Regulatory agencies have often required power plants to operate at low excess temperatures (deltaT) because thermal stresses are believed to be the primary cause of mortality to organisms entrained by the once-through cooling systems of electric generating stations. This practice results in the use of large volumes of cooling water to achieve the mandated low excess temperatures. Operation of power plants below upper tolerable temperatures results in the entrainment of unnecessarily high numbers of organisms, and may cause a higher total mortality rate than would result from operating the power plant at higher temperatures and using a lower volume of cooling water. Variations in cooling water flow resulting from changes in the number or capacity of circulating pumps in operation alter the number of organisms entrained, the magnitude of the deltaT, and, as a result, the mortality rate of entrained organisms. It has become accepted scientific practice to calculate safe levels of toxics, including thermal stress. Procedures to determine the temperature and cooling water flow characteristics which minimize entrainment mortality were developed and applied. The operating conditions of a power plant on the Potomac River were examined as a case-study to determine whether the plant was operating at, below, or above a maximum tolerable deltaT. This method may be applied to power plants to determine if entrainment mortality due to thermal effects may occur and what alterations in cooling water flow would minimize entrainment mortality to selected representative important species. (Author's abstract)
W87-06786

CONSEQUENCES ASSOCIATED WITH A CRUDE PETROLEUM LEAK FROM A PIPELINE,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W87-06787

STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM: GROUND WATER RESEARCH,
Geological Survey, Reston, VA. Office of Water Data Coordination.
For primary bibliographic entry see Field 5B.
W87-06852

RMA SOUTHERN TIER CONTAMINATION SURVEY,
Dames and Moore, Bethesda, MD.
For primary bibliographic entry see Field 5B.
W87-06854

CONTRIBUTION OF THIOSULFATE TO CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND IN OIL SHALE PROCESS WASTEWATER,
Battelle Pacific Northwest Labs., Richland, WA.
A. L. Wong, and B. W. Mercer.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 56-67, 1 fig, 2 tab, 7 ref. DOE Contract EY-76-C-06-1830.

Descriptors: *Thiosulfates, *Process water, *Chemical oxygen demand, *Biochemical oxygen demand, *Oil shale, *Industrial wastewater, *Water pollution effects, *Water analysis, Chemical analysis, Sulfur bacteria, Wastewater.

Thiosulfate accounted for a significant portion of the chemical oxygen demand (COD) (7-20%) and the biochemical oxygen demand (BOD) (14-41%) of the four oil shale process waters studied. Accurate measurement of the thiosulfate oxygen demand of retort water is critical in assessing its environmental impacts on receiving waters and in designing biological treatment systems to treat it. The contribution of thiosulfate to the COD of oil shale retort waters can be accurately measured in a standard COD test. The BOD of thiosulfate in retort water is more difficult to determine and may require the development of a special thiosulfate-acclimated seed. Thiosulfate recovery of a known thiosulfate spike ranged from 92-100% in the COD test and from 54-119% in the BOD tests. Considerable variability in recovery was found between the process waters studied. When determining the BOD of oil shale process waters, care must be taken to insure that there is a viable population of thiosulfate-oxidizing bacteria. (See also W87-06871) (Author's abstract)
W87-06876

MUTAGENICITY TESTING OF AQUEOUS MATERIALS FROM ALTERNATE FUEL PRODUCTION,
Oak Ridge National Lab., TN. Biology Div.
T. K. Rao, F. W. Larimer, C. E. Nix, and J. L. Epler.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 68-75, 1 fig, 4 tab, 7 ref. EPA IAG-D5-E681, Interagency Agreement No. 40-516-75., and DOE Contract W-7405-eng-26.

Descriptors: *Bioassay, *Toxicity, *Mutagenicity, *Fuel, *Water pollution effects, *Water analysis, Oil shale, Ames assay, Chromatography, Aquatic toxicology, Effluents, Comparison studies.

In a multidisciplinary effort, the authors attempt to establish a database for toxicity evaluation of a variety of aqueous effluents and aqueous extracts from solid wastes from fossil fuels, synthetic fuels, and shale oil derived fuels. In genetic toxicology testing, short-term mutagenicity tests, including bacterial, fungal, insect, and mammalian cell systems, have been applied in a comparative sense to exemplary test materials. The Salmonella histidine reversion assay (Ames test) has been shown to be generally applicable, especially when utilized with chemically fractionated materials. Liquid-liquid extraction and column chromatography are used to separate crude test materials into defined fractions for bioassay, paralleled by chemical analyses. The test materials have included various crude oils and product waters along with extracts from raw shale and processed shale. The mutagenic materials were observed and quantitated. Extrapolations to specific compounds and to the overall biological hazard of the test materials are in progress. Comparative studies with samples from existing petroleum technologies and fossil fuel processes are being carried out. (See also W87-06871) (Author's abstract)
W87-06877

VALIDATION AND PREDICTABILITY OF LABORATORY METHODS FOR ASSESSING THE FATE AND EFFECTS OF CONTAMINANTS IN AQUATIC ECOSYSTEMS.
American Society for Testing and Materials, Philadelphia, PA.
A Symposium Sponsored by The American Institute of Biology and The Applied and Aquatic Section of the Ecological Society of America and ASTM Committee E-47 on Biological Effects and Environmental Fate, Grand Forks, North Dakota, August 8, 1983. Edited by T.P. Boyle. 1985. 233 p.

Descriptors: *Symposium, *Ecosystems, *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Xenobiotic chemicals, Toxicity, Environmental effects, Aquatic environment, Ecological effects.

The assessment of the fate and effect of xenobiotic chemicals in the environment has evolved over the past several years into three categories: (1) assessment of the effects of a contaminant at the organism level in standardized acute and chronic tests; (2) assessment of contaminants at the population, community, and ecosystem level using laboratory microcosms; and (3) assessment of environmental exposure and fate of contaminants using mathematical modeling techniques. There have been increasing expressions of need among managers, decision makers, and scientists to validate and establish the limits of predictability of these assessment procedures. The term validate, in the sense of this book, means establishing the effectiveness of an assessment procedure by substantiating the degree of accuracy. This implies formulation of procedures for comparison of laboratory and field generated data. The term predictability implies determining the ability to forecast from laboratory results to what could be expected in a real-world situation. This involves specific advice to users of laboratory data as to the level of confidence and limits of extrapolation. Establishing the validity and determination of the predictability of assessment procedures must depend on specific sets of hypotheses that both qualify and quantify: (1) the set of environmental variables that are critical in determining differences in exposures and response of organisms to a chemical in laboratory and field; (2) the magnitude of potential indirect effects; and (3) the relative sensitivity of organisms in the laboratory and field. (See also W87-06913 thru W87-06927) (Author's abstract)
W87-06912

COMPARISON OF ENVIRONMENTAL EFFECT AND BIOTRANSFORMATION OF TOXICANTS ON LABORATORY MICROCOSM AND FIELD MICROBIAL COMMUNITIES,
Louisiana State Univ., Baton Rouge.
R. J. Portier.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 14-30, 3 fig, 4 tab, 17 ref. NOAA Grant NA 81-AA-D-0046; EPA Grant R-804976.

Descriptors: *Biodegradation, *Laboratory microcosms, *Environmental effects, *Fate of pollutants, *Water pollution effects, Toxicity, Wetlands, Microbial density, Phosphatase, Dehydrogenase, Adenosine triphosphate, Simulation analysis, Hydrogen ion concentration, Conductivity, Salinity, Enzymes, Statistical analysis, Population exposure, Pesticides, Organic compounds.

Measurements of microbial density, phosphatase and dehydrogenase activity, adenosine triphosphate (ATP), fluorescin diacete hydrolysis, and the mineralization of toxicant parent molecules were evaluated both in the coastal wetland environment and under laboratory microcosm simulation for different pH/Eh, salinity, temperature, and sediment/water interface conditions. The combining of microbial and enzymatic approaches with environmental correlations, support the value of the benchtop microcosm as an analytical tool. Rates of utilization and the breakdown of product generation can be effectively monitored. Varying rates of utilization and biotransformation of two dissimilar chemical toxicants, e.g., methyl parathion and Kepone, can be discerned within the microcosm. The rapid disappearance of methyl parathion coincides closely with field results. The ATP and other enzymatic tests provide sensitive indications of initial degradation of the parent compound, and can be used as early indices for fate analysis. Axenic flask studies have confirmed these findings. Control microcosm units have repeatedly reflected a microbial biomass comparable with that found in control field sites and have also exhibited comparable microbial density and specific enzyme levels. Exposed microcosms, statistically identical to control units, provided reproducible information on initial environmental effects, as well as data on the environmental fate of the target pesticides. Variations in microbial biomass, microbial density, and specific enzyme level responses were more apparent and precise in exposed microcosms than in exposed field sites. Comprehensive statistical analysis of all parameters analyzed in field plots provided a correlation matrix similar, if not at times identical, to comparable multivariant studies of microcosm parameters. (See also W87-06912) (Lantz-PTT)
W87-06914

USE OF A THREE-PHASE MICROCOSM FOR ANALYSIS OF CONTAMINANT STRESS ON AQUATIC ECOSYSTEMS,
Tennessee Technological Univ., Cookeville.
For primary bibliographic entry see Field 5B.
W87-06915

COMPARISON OF LABORATORY MICROCOSMS AND FIELD RESPONSES TO COPPER,
Washington Univ., Seattle. School of Fisheries.
M. C. Harrass, and F. B. Taub.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 57-74, 10 fig, 47 ref. FDA Contracts 223-80-2352 and 223-83-7000.

Descriptors: *Water pollution effects, *Limnology, *Microcosms, *Copper, *Bioassay, Algae, Toxicity, Daphnia, Ecosystems, Pesticides, Comparison studies.

As a biological model, a Standardized Aquatic Microcosm has demonstrated trophic interactions and community recovery after pesticide treatment. Daphnia magna were temporarily eliminated by treatment with 0.5 mg/L copper, leading to changes in algal and rotifer densities. Algae were severely affected by treatment with 2.0 mg/L copper, demonstrating altered dominance and productivity. Recovery of treated communities after inactivation or isolation of active toxicant was demonstrated by populations attaining densities equivalent to control communities. Comparison with published studies of natural communities treated with copper indicates that similar trophic interactions have often been demonstrated, although field studies suggested that responses are quite variable. (See also W87-06912) (Author's abstract)
W87-06917

EFFECTS OF ATRAZINE ON COMMUNITY LEVEL RESPONSES IN TAUB MICROCOSMS,
Corvallis Environmental Research Lab., OR.
F. S. Stay, D. P. Larsen, A. Katko, and C. M. Rohm.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 75-90, 7 fig, 2 tab, 29 ref.

Descriptors: *Atrazine, *Taub microcosms, *Limnology, *Ecosystems, *Water pollution effects, Environmental effects, Bioassay, Toxicity, Primary productivity, Respiration, Daphnia, Aquatic environment, Herbicides, Population exposure.

As part of a study to evaluate laboratory toxicity tests that include single species bioassays and microcosms, community level responses in Taub microcosms exposed to atrazine (60, 100, 200, 500, 1000, and 5000 micrograms/L), a commonly used herbicide, were examined. Measurements of community metabolism included primary productivity, community respiration, primary production efficiency, and productivity/respiration ratios. These community measurements varied in their sensitivity to atrazine. Primary production efficiency (primary productivity per unit chlorophyll) appeared to be the most sensitive measurement, with greatly reduced efficiencies occurring throughout the experiment at atrazine exposures of 60 micrograms/L. The other community measures appeared to be more sensitive to atrazine during the interval when Daphnia magna populations were highest, suggesting increased pressure by D. magna on primary producers increased the sensitivity of this test system to atrazine. All community metabolism measurements of the microcosms exposed to higher atrazine concentrations of 500, 1000, and 5000 micrograms/L differed from controls throughout the experiment. (See also W87-06912) (Author's abstract)
W87-06918

EXPERIMENTAL PONDS FOR EVALUATING BIOASSAY PREDICTIONS,
Kansas Univ., Lawrence. Experimental and Applied Ecology Program.
F. de Noyelles, and W. D. Kettle.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 91-103, 5 fig, 58 ref. NSF Grant 75-23389; EPA Contracts R806641010 and CR808804010.

Descriptors: *Limnology, *Bioindicators, *Water pollution effects, *Experimental ponds, *Bioassay, *Environmental effects, Atrazine, Hydrogen ion concentration, Herbicides, Photosynthesis, Comparison studies, Bioaccumulation.

Experimental pond studies were used to demonstrate a method for assessing the accuracy of laboratory and in situ bioassays, predicting the effects of chemical stress on phytoplankton. A short-term batch bioassay, using changing carbon uptake in photosynthesis, predicted an immediate (first 24 hr) effect of the herbicide atrazine on the phytoplankton communities in experimental ponds. After adding atrazine to the ponds, the same decreases in carbon uptake were observed, but the appearance of resistant species soon occurred which could not be predicted with the short-term exposure used in the bioassay. From another experimental pond study a longer-term, continuous flow bioassay, using changing species composition, predicted the effects of increased nutrient, and altered pH conditions over a 20-day exposure. With these same perturbations applied to experimental ponds, the same series of responses were observed. Comparison of responses in the experimental ponds with those in the bioassays was also used to demonstrate the general limits of applicability for each bioassay. (See also W87-06912) (Author's abstract)
W87-06919

CALIBRATION OF LABORATORY BIOASSAYS WITH RESULTS FROM MICROCOSMS AND PONDS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. M. Giddings, and P. J. Franco.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, Ecological Soc. of America, and ASTM Committee E047, Grand Forks, North Dakota, August 8, 1983. 1985. p 104-119, 3 fig, 5 tab, 32 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Biaossay, *Limnology, *Water pollution effects, *Ponds, *Microcosms, Organic compounds, Phenols, Hydrocarbons, Daphnia, Zooplankton, Lethal limit, Model studies, Comparison studies, Calibrations, Population exposure.

Effects of an organic contaminant (a synthetic coal-derived crude oil) were measured in outdoor ponds and indoor pond-derived microcosms and compared with results of laboratory bioassays. Ponds and microcosms were treated with the oil continuously for eight weeks. Concentrations of phenolic compounds (the major water-soluble constituents of the oil) spanned the range of acute and chronic toxicity concentrations determined in

single-species bioassays. Effects were similar in microcosms and ponds, implying that microcosms are suitable models for field studies for some purposes. Significant changes in community metabolism and zooplankton populations occurred in microcosms and ponds exposed to less than 0.05 mg/L phenols, near the 28-day lowest observed effect concentration (LOEC) for Daphnia magna. Ponds and microcosms were seriously damaged at concentrations near acute bioassay mean lethal concentration (LC sub 50) values. Indirect effects in the ecosystems occurred at all treatment levels, and included changes in water quality, replacement of sensitive taxa by more tolerant competitors, and changes in abundance of some species because of increases or decreases in their predators or grazers. The safe exposure level determined from the ecosystem experiments was accurately predicted by an application factor of 0.03 in conjunction with the most sensitive acutebioassay result (the D. magna 48-hr LC sub 50). Less conservative extrapolation methods over estimated the safe concentration of this material in these ecosystems. (See also W87-06912) (Author's abstract)
W87-06920

COMPARISON OF LABORATORY AND FIELD ASSESSMENT OF FLUORENE - PART I: EFFECTS OF FLUORENE ON THE SURVIVAL, GROWTH, REPRODUCTION, AND BEHAVIOR OF AQUATIC ORGANISMS IN LABORATORY TESTS,
Columbia National Fisheries Research Lab., MO.
S. E. Finger, E. F. Little, M. G. Henry, J. F. Fairchild, and T. P. Boyle.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, ND, Aug. 8, 1983. 1985. p 120-133, 2 fig, 6 tab, 32 ref. EPA IAG AD-14F-2A075.

Descriptors: *Bioindicators, *Field tests, *Fluorene, *Aquatic life, *Water pollution effects, Daphnia, Midges, Amphipods, Snails, Mayflies, Trout, Minnows, Macrophytes, Aquatic plants, Algae, Fish, Toxicity, Hydrocarbons.

Static toxicity tests were conducted with the polycyclic aromatic hydrocarbon fluorene on daphnids, larval midges, amphipods, snails, mayflies, bluegill, rainbow trout, fathead minnows, aquatic macrophytes, and green algae. Daphnia was the most sensitive organism tested with a 48-hr median effective concentration (EC sub 50) of 0.43 mg/L. Fathead minnows were the least sensitive species, with no mortality at fluorene concentrations as high as 100 mg/L. In a 14-day test, fluorene exposure inhibited algal production at a threshold level of approximately 3.0 mg/L. Complete life cycle chronic toxicity tests were conducted with fluorene on daphnids and larval midges. Daphnid reproduction was significantly reduced at fluorene levels of 0.125 mg/L after 14 days. Emergence of larval midges was delayed at a concentration of 0.6 mg/L. In a 30-day partial life cycle study that was conducted to determine the impact of fluorene on growth, survival, and behavior of fingerling bluegill, survival was reduced at exposures of 0.5 and 1.0 mg/L and growth was inhibited at exposures of 0.25, 0.5, and 1.0 mg/L. Measurements of several behavioral characteristics indicated impairment of swimming and feeding activities at fluorene concentrations as low as 0.12 mg/L. Vulnerability of bluegill to predation was also increased by fluorene exposure. Results of these behavioral tests indicated that fish were adversely affected at fluorene levels below those predicted by the standard chronic toxicity measurements of growth and survival. (See W87-09912, see also W87-06922; (Author's abstract)
W87-06921

COMPARISON OF LABORATORY AND FIELD ASSESSMENT OF FLUORENE - PART II: EFFECTS ON THE ECOLOGICAL STRUCTURE AND FUNCTION OF EXPERIMENTAL POND ECOSYSTEMS,
Columbia National Fisheries Research Lab., MO.
T. P. Boyle, S. E. Finger, R. L. Paulson, and C. F. Rabeni.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Ecological Soc. of America, and ASTM Committee E-47, Grand Forks, ND, Aug. 8, 1983. 1985. p 134-151, 6 fig, 6 tab, 27 ref, append. EPA IAG AD-14F-2A075.

Descriptors: *Bioindicators, *Field tests, *Fluorene, *Water pollution effects, *Ecosystems, *Experimental ponds, Ecological effects, Zooplankton, Hydrocarbons, Bass, Bluegills, Fish, Toxicity, Rotifers.

Fourteen experimental ponds were dosed with the energy-related polynuclear aromatic hydrocarbons fluorene to effect nominal concentrations of 0.12, 0.5, 2.0, 5.0, and 10.0 mg/L. Measurement of emergent aquatic insects revealed no effects due to fluorene application. Zooplankton density was drastically reduced by treatments at 5.0 and 10.0 mg/L; however, it recovered in one to three weeks due to an increase in the number of rotifers that replaced the crustacean zooplankton killed by fluorene. Species richness of the zooplankton community was also reduced by the treatments at 5.0 and 10.0 mg/L. The survival and yield of both largemouth bass (Micropterus salmoides) and bluegills (Lepomis macrochirus) were reduced by the treatment of 0.12 mg/L, as were the production and survival of bluegill recruits. The mean increase in weight of adult and recruit bluegills was inversely related to the number surviving, indicating that fluorene toxicity induced a secondary response in the restructuring of the fish community. A comparison of algae and invertebrate laboratory toxicity test results with data with the pond studies revealed that these organisms were more sensitive to fluorene in the laboratory. However, the two species of fish in the ponds were more sensitive to fluorene than in routine laboratory tests. (See also W87-06912, see also W87-06921) (Author's abstract)
W87-06922

SEDIMENT TOXICITY, CONTAMINATION, AND MACROBENTHIC COMMUNITIES NEAR A LARGE SEWAGE OUTFALL,
Environmental Research Lab.-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.
R. C. Swartz, D. W. Schults, G. R. Ditsworth, W. A. DeBen, and F. A. Cole.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, ND, Aug. 8, 1983. 1985. p 152-175, 4 fig, 12 tab, 31 ref.

Descriptors: *Bioassay, *Waste disposal, *Water pollution effects, *Sediment toxicity, *Macrobenthos, *Outfall sewers, *Palos Verdes Shelf, *California, Sediments, Statistical studies, Model studies, Biomass, Toxicity, Clams, Polycheaetes, Benthos, Ecological effects.

Sediment toxicity, contamination, and macrobenthic community structure were examined in 1980 at seven stations along a pollution gradient from the Los Angeles County Sanitation Districts' sewage outfalls on the Palos Verdes Shelf, CA, to control conditions in Santa Monica Bay. Sediment toxicity was determined by laboratory bioassays with the phoxocephalid amphipod, Rhepoxynius abronius. Distribution and abundance of the macrobenthos were generally consistent with the Pearson-Rosenberg model and the Bascom-Mearns-Word quantitative classification of macrobenthic assemblages. Species richness, density, and biomass increased greatly in areas of moderate sediment organic enrichment, but decreased to or below control conditions near the outfalls. The Infaunal Index of changes in benthic community structure in response to organic enrichment increased with distance from the outfalls. Dominant species changed from the opportunistic polychaete, Capitella Capitata, near the outfalls; to the clam, Parvilucina tenuisculpta, and the polychaetes, Mediomastus californiensis and Tharyx sp. A in areas of moderate organic enrichment; to the brittlestar, Amphiodia urtica, at the control station. Sediment toxicity was significantly greater than control levels at the three stations closest (< or = 3 km) to the outfalls. There were significant increases in the concentration of most sediment contaminants and significant decreases in the richness and abundance of the benthos at stations where sediment was acutely toxic to R. abrunius. Organic enrichment and anaerobic sediment conditions appear to be the dominant anthropogenic influences on the macrobenthos of the Palos Verdes Shelf. Toxicity caused by chemical contamination may contribute to the absence of amphipods near the sewage outfalls. (See also W87-06912) (Author's abstract)
W87-06923

CONCEPT OF PROGNOSTIC MODEL ASSESSMENT OF TOXIC CHEMICAL FATE,
Oregon State Univ., Corvallis. Dept. of Statistics.
For primary bibliographic entry see Field 5B.
W87-06925

EFFECTS OF ATRAZINE ON AQUATIC ECOSYSTEMS: A PHYSICAL AND MATHEMATICAL MODELING ASSESSMENT,
State Univ. of New York Coll. at Plattsburgh. Center for Earth and Environmental Science.
J. L. Malanchuk, and H. P. Kollig.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Applied and Aquatic Sect. of the Ecological Soc. of America, and ASTM Committee E047, Grand Forks, ND, Aug. 8, 1983. 1985. p 212-224, 7 fig, 3 tab, 17 ref.

Descriptors: *Cycling nutrients, *Water pollution effects, *Atrazine, *Mathematical models, *Model studies, Environmental effects, Hydrogen ion concentration, Dissolved oxygen, Nutrients, Aquatic environment, Herbicides, Ecosystems, Hazard assessment.

Physical and mathematical models were employed to determine the effects of atrazine on pH, dissolved oxygen, and dissolved nutrients in aquatic systems. The data show that changes in measured variables are observed in the presence of toxicant but that systems recover rapidly when toxicant input ceases. Simple linear donor-controlled mathematical models of nutrient cycles are capable of simulating the effect, although sufficient model detail should be incorporated to account for direct and indirect effects and to improve verification. System measurements are responsive in terms of disruption and recovery. Changes in nutrient cycling patterns should be incorporated into thehazard evaluation process. (See also W87-06912) (Author's abstract)
W87-06927

PEARL HARBOR DREDGED-MATERIAL DISPOSAL,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 5E.
W87-06983

FACTORS AFFECTING UPTAKE OF CADMIUM AND OTHER TRACE METALS FROM MARINE SEDIMENTS BY SOME BOTTOM-DWELLING MARINE INVERTEBRATES,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
For primary bibliographic entry see Field 5B.
W87-06988

CHANGES IN THE LEVELS OF PCBS IN MYTILUS EDULIS ASSOCIATED WITH DREDGED-MATERIAL DISPOSAL,
Connecticut Univ., Groton. Marine Sciences Inst.
For primary bibliographic entry see Field 5B.
W87-06989

ACIDIFICATION OF SURFACE WATERS IN EASTERN CANADA AND ITS RELATIONSHIP TO AQUATIC BIOTA,
Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Fisheries Research Branch.
For primary bibliographic entry see Field 2H.
W87-06997

USE OF SHORT-TERM BIOASSAYS TO EVALUATE ENVIRONMENTAL IMPACT OF LAND TREATMENT OF HAZARDOUS INDUSTRIAL WASTE,
Texas Agricultural Experiment Station, College Station.
K. W. Brown, K. C. Donnelly, and J. C. Thomas.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-232560, Price codes: A17 in paper copy, A01 in microfiche. Report No. EPA-600/2-84-135, August 1984. 357 p, 146 fig, 96 tab, 196 ref. EPA Grant CR-807701-01.

Descriptors: *Bioassay, *Environmental effects, *Water pollution effects, *Waste disposal, *Land disposal, Industrial wastes, Microbiological studies, Monitoring.

A four phase study was conducted to evaluate utility of short-term bioassays in monitoring environmental impact of land treatment of hazardous waste. During phase one, three microbial bioassays were conducted to define chronic toxic potential of each waste selected for study. Acid, base, and neutral fractions of each of three wastes studied inducted genetic damage in at least two of the three bioassays. Phase two was conducted to evaluate efficiencies of blender and soxhlet extraction procedures, as well as potential interactions between known mutagens and soil components. Results indicate that there was no appreciable difference in mutagenicity of the extract using either procedure. Using the blender procedure extraction efficiency for pure compounds added to soil averaged greater than 85%, as measured by high pressure liquid chromatography. Phase three consisted of a greenhouse study in which each of three wastes was applied to two soils. Results from chemical analyses indicate that waste constituents were degraded in soil during a 360 or 340 day interval. Increased mutagenic activity was exhibited in some soil and water extracts during this same interval. When compared on an equivalent volume basis, however, mutagenic potential of waste-amended soils was reduced over time and, in some cases, was reduced to a non-mutagenic level. Wood-preserving bottom sediment was applied to barrel-sized lysimeters in the final project phase to compare results of soil-core and soil-pore liquid monitoring. Different types of compounds were detected in soil core and soil pore liquid samples. (Author's abstract)
W87-07003

EVALUATION OF WATERBORNE RADON IMPACT ON INDOOR AIR QUALITY AND ASSESSMENT OF CONTROL OPTIONS,
Envirodyne Engineers, Inc., St. Louis, MO.
A. P. Becker, and T. M. Lachajczyk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-246404. Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/7-84-093, Sept. 1984. 133 p, 29 fig, 43 tab, 184 ref. EPA Contract 68-02-3178.

Descriptors: *Water pollution effects, *Radon, *Air pollution, Air quality, Environmental effects, Water pollution treatment, Literature reviews, Activated carbon, Aeration.

This report contains a review of radon's physical, chemical and radiological properties; a summary of its decay chain; and a synopsis of health risks, existing regulations, and recommendations concerning exposure to radon and progeny. Although the report is primarily concerned with air concentrations of radon and progeny resulting from waterborne sources, other potential sources (home subsurface, construction materials, fuel and ambient air) and their potential impacts on indoor air quality are also discussed. The results of a literature search conducted to identify and summarize research by investigators in the United States and foreign countries concerning the concentration of waterborne radon (C sub w) and its effects on the indoor air concentration of radon (C sub a) is presented. The major factors which influence C sub a/ C sub w (including ventilation rate, water transfer efficiency, water use rates, and volume of the home) are examined. Sensitivity analyses are conducted to mathematically define a representative value of C sub a/C sub w (0.00007) and its reasonable bounds (0.0017 to 0.0035). Also presented are assessments of reported techniques for removal of radon from water or indoor air. Techniques evaluated for removal of radon from water include decay, aeration and granular activated carbon. Techniques evaluated for removal of radon and/or progeny from air include circulation, various types of ventilation, filtration, electrostatic precipitation, charcoal adsorption, chemical reaction, and space charging. Where the reports examined include a sufficient amount of information to do so, an evaluation of the cost, efficiency and practicality of each technique is provided. (Author's abstract)
W87-07024

SEASONAL ABUNDANCE AND HABITAT-USE PATTERNS OF COASTAL BIRD POPULATIONS ON PADRE AND MUSTANG ISLAND BARRIER BEACHES (FOLLOWING THE IXTOC I OIL SPILL),
Corpus Christi State Univ., TX. Dept. of Biology.
B. R. Chapman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-236876. Price codes: A05-PC in papercopy, A01-MF in microfiche. Fish and Wildlife Service Report No. FWS/OBS-83/31, February 1984. 73 p, 16 fig, 8 tab, 14 ref. DOI Contract 14-16-0009-80-062.

Descriptors: *Water pollution effects, *Ecological effects, *Oil spills, *Texas, *Water birds, Birds, Seasonal variation, Waterfowl, Species diversity.

This report resulted from a continuation of studies begun just before oil slicks and tar balls from the Ixtoc I oil-well blowout began washing ashore on south Texas beaches. The purposes of this study were twofold: to assess the impact of the Ixtoc I oil spill on coastal bird populations and to provide baseline information about the distribution and seasonal abundance of the avian species that use south Texas beach and nearshore habitats. The report synthesizes all available data on waterbirds in the study area, including the results of censuses made from October 1979 through June 1981. The information is presented in two sections: a results and discussion section describes the annual, seasonal, and daily cycles of avian abundance, distribution, and diversity. The species profiles provide distribution, status, seasonal abundance, habitat-use patterns, and oil vulnerability information for 26 species. (Lantz-PTT)
W87-07032

COMPARATIVE STUDIES OF PHYTOTOXICITY AND CHEMICAL COMPOSITION OF AQUEOUS OIL SOLUTIONS AFFECTED BY EVAPORATION, ILLUMINATION AND EXTRACTION,
Norges Tekniske Hoegskole, Trondheim. Inst. of Marine Biochemistry.
K. Ostgaard, A. Aaberg, J. Klungsoyr, and A. Jensen.
Water Research WATRAG, Vol. 21, No. 2, p 155-164, February 1987. 2 fig, 8 tab, 32 ref.

Descriptors: *Water pollution effects, *Phytotoxicity, *Toxicity, *Diatoms, *Oil spills, *Hydrocarbons, *Sample preparation, Comparison studies, Oily water, Solutions, Oxidation.

Aqueous stock solutions of Ekofisk crude oil were prepared in darkness and under illumination, and fractions of both types of stock solutions were further treated by controlled evaporation, illumination, extraction with hexane and dichloromethane and phytoplankton cultivation. Chemical analysis of all fractions were combined with toxicity testing based on the marine diatom Skeletonema costatum. Removal of the readily water-soluable aromatic hydrocarbons did not reduce the phytotoxicity of the solutions. Illumination led to a dramatic increase in both toxicity and the total amount of dissolved material. In no case did the hydrocarbon content exceed 5% of the total dissolved material, and the traditional analytical values referred to as 'total hydrocarbon content' are therefore considered highly misleading. The toxicity of these aqueous oil solutions must apparently be ascribed to a multidue of slightly polar, oxidized compounds originating from the oil. (Author's abstract)
W87-07050

COEFFICIENT OF COMMUNITY LOSS TO ASSESS DETRIMENTAL CHANGE IN AQUATIC COMMUNITIES,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5E.
W87-07058

TOXICITY OF SODIUM SELENITE TO RAINBOW TROUT FRY,
Columbia National Fisheries Research Lab., MO.
J. B. Hunn, S. J. Hamilton, and D. R. Buckler.
Water Research WATRAG, Vol. 21, No. 2, p 233-238, February 1987. 4 tab, 40 ref.

Descriptors: *Water pollution effects, *Selenites, *Selenium, *Toxicity, *Survival, *Trout, Population exposure, Tissue analysis, Calcium, Fish physiology.

In a study designed to examine the long-term effects of inorganic selenium (IV) on early life stages of rainbow trout (Salmo gairdneri), survival was significantly reduced at selenium concentrations of 47 and 100 microgram(ug)/L after 90 days of exposure. Length and weight were significantly reduced after 90 days of exposure to 100 ug/L. Whole-body residues of selenium increased with increasing exposure concentrations but appeared to decline between 30 and 90 days of exposure. Analyses of trout backbone indicated little change in bone development with exposure to selenium (IV) with one exception; calcium concentrations were significantly decreased in fish exposed to $>$ or $=$ 12 ug/L of selenium. Results of our study indicates that a recommended safe level of 10 ug/L for inorganic selenium would not significantly affect growth and survival of rainbow trout; however, concentrations of selenium near this level can reduce the levels of calcium in the backbones of trout. (Author's abstract)
W87-07061

PROPOSAL OF ECOTOXICOLOGICAL CRITERIA FOR THE ASSESSMENT OF THE IMPACT OF POLLUTION ON ENVIRONMENTAL QUALITY,
Paris-11 Univ., Orsay (France).
F. Ramade.
Toxicological and Environmental Chemistry TXECBP, Vol. 13, No. 3/4, p 189-203, January 1987. 3 fig, 3 tab, 17 ref.

Descriptors: *Ecotoxicology, *Water pollution effects, *Environmental effects, *Bioindicators, *Biocoenotic indices, Numerical analysis.

The major ecotoxicological criteria that are presently in current use for the detection of environmental pollution and in the assessment of its biological impact are discussed. In addition to the widespread use of bioindicator species, more recent criteria relying on biocoenotic indexes were proposed. Other methods, more complex are intended to compare the effects of a given pollution on communities structure. They stem from the computation of importance value curves or even on the factorial analysis of correspondence. Ultimately, the determination of the variations in primary and (on) secondary productivity may be achieved in order to appraise accurately the impact of a given ambient contamination on the productivity of the affected communities. (Author's abstract)
W87-07072

ALIPHATIC AND AROMATIC HALOCARBONS AS POTENTIAL MUTAGENS IN DRINKING WATER: PART 1. HALOGENATED METHANES,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
K. Strobel, and T. Grummt.
Toxicological and Environmental Chemistry TXECBP, Vol. 13, No. 3/4, p 205-221, January 1987. 1 fig, 4 tab, 57 ref.

Descriptors: *Water pollution effects, *Halogenated methanes, *Halocarbons, *Chlorination, *Mutagens, *Drinking water, Ames test, Cultures, Bioassay, Organic compounds, Trihalomethanes, Hydrocarbons.

Members of the group of halogenated methanes can either be formed during chlorination of drinking water or are of commercial importance and therefore produced in considerable amounts. Out of this group, Dichloromethane (DCM), Bromodichloromethane (BDM), Bromochloromethane (BCM),Bromotrichloromethane (BTM) and Dibromomethane (DBM) were tested for their mutagenic activity. The Ames-test and in vitro cell cultures were used. All substances were positive in the Ames-test. In the in vitro test with FAF-cells of Chinese hamsters only BCM produced an increase of the SCE-frequency. All tested substances induced an increase in the aberration ratio/cell. The highest ratios were induced by DCM, DBM and BCM. (Author's abstract)
W87-07073

LONG-TERM EFFECTS OF METAL-RICH SEWAGE SLUDGE APPLICATION ON SOIL POPULATIONS OF BRADYRHIZOBIUM JAPONICUM,
Maryland Univ., College Park. Dept. of Agronomy.
B. K. Kinkle, J. S. Angle, and H. H. Keyser.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 2, p 315-319, February 1987. 2 tab, 34 ref.

Descriptors: *Rhizobia, *Waste disposal, *Sludge disposal, *Land disposal, *Heavy metals, *Soil bacteria, Sensitivity, Field tests, Soybeans, Silt, Loam.

The application of sewage sludge to land may increase the concentration of heavy metals in soil. Of considerable concern is the effect of heavy metals on soil microorganisms, especially those involved in the biocycling of elements important to soil productivity. Bradyrhizobium japonicum is a soil bacterium involved in symbiotic nitrogen fixation with Glycine max, the common soybean. To examine the effect of metal-rich sludge application on B. japonicum, the MICs for Pb, Cu, Al, Fe, Ni, Zn, Cd, and Hg were determined in minimal media by using laboratory reference strains representing 11 common serogroups of B. japonicum. Marked differences were found among the B. japonicum strains for sensitivity to Cu, Cd, Zn, and Ni. Strain USDA 123 was most sensitive to these metals, whereas strain USDA 122 was most resistant. In field studies, a silt loam soil amended 11 years ago with 0, 56, or 112 Mg of digested sludge per ha was examined for total numbers of B. japonicum by using the most probable number method. Nodule isolates from soybean nodules grown on this soil were serologically typed, and their metal sensitivity was determined. The number of soybean rhizobia in the sludge-amended soils was found to increase with increasing rates of sludge. Soybean rhizobia strains from 11 serogroups were identified in the soils; however, no differences in serogroup distribution or proportion of resistant strains were found between the soils. Thus, the application of heavy metal-containing sewage sludge did not have a long-term detrimental effect on soil rhizobial numbers, nor did it result in a shift in nodule serogroup distribution. (Author's abstract)
W87-07077

BACTERIAL COMMUNITIES IN ACIDIC AND CIRCUMNEUTRAL STREAMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
A. V. Palumbo, M. A. Bogle, R. R. Turner, J. W. Elwood, and P. J. Mulholland.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 2, p 337-344, February 1987. 3 fig, 7 tab, 35 ref. Electric Power Research Inst. Contract RP2326-I and DOE Contract DE-ACO5-840R21400.

Descriptors: *Isotope studies, *Acidic water, *Hydrogen ion concentration, *Bacteria, *Acid streams, Biomass, Streams, Plankton, Seston, Sediments, Population dynamics, Sensitivity.

The relationship between pH and the abundance and activity of bacteria in streams was examined as part of a study of the effect of acidification on stream communities. Of the bacterial communities examined, the epilithic community appeared to be the most significantly affected by acidification. Microbial biomass, as quantified by measuring the ATP level, on rock surfaces was significantly correlated with pH. Also, bacterial production by the epilithic bacteria, indicated by incorporation of tritiated thymidine into DNA, was always higher at high-pH sites than at low-pH sites of the same stream order and elevation. Bacterioplankton concentrations varied between 53000 to 942000 cells/ml in the first- to fourth-order streams examined. The bacterioplankton concentration in one sample from a spring was 17000 cells/ml. Bacterioplankton concentrations were not correlated with pH but were significantly correlated with seston concentrations. The correlation with seston is a result of increases in particle-associated bacteria at high seston concentrations. The proportion of bacterioplankton attached to particles varied from 0 to 70%. Bacterial numbers and production in the sediments were significantly correlated with the organic content of the sediment rather than with the pH of the overlying water. Thus, reduced abundance and activity of bacteria as a result of acidification could be detected only for the relatively active community on rock surfaces; this community was exposed to the low pH because of the unbuffered nature of its environment. (Author's abstract)
W87-07078

SUMMARY OF REPORTED FISH KILLS IN KANSAS DURING 1983,
Kansas Fish and Game Commission, Pratt. Fisheries Div.
For primary bibliographic entry see Field 2H.
W87-07091

PESTICIDE-INDUCED IMPAIRMENT OF THYROID PHYSIOLOGY IN THE FRESHWATER CATFISH, HETEROPNEUSTES FOSSILIS,
Banaras Hindu Univ., Varanasi (India). Fish Endocrinology Lab.
A. K. Yadav, and T. P. Singh.
Environmental Pollution, Vol. 43, No. 1, p 29-38, January 1987. 3 tab, 32 ref. DOE J-13013/18/83-EN-I and ICAR Grant FG-IN-620 for Project INARS-213.

Descriptors: *Water pollution effects, *Pesticides, *BHC, *Malathion, *Catfish, *Fish physiology, Thyroid, Organochlorine pesticides, Organophosphorus pesticides, Enzymes, Water pollution, Sublethal effects.

Effects of the organochlorine pesticide BHC (8 milligrams/liter) and the organophosphorus pesticide malathion (10 milligrams/liter) exposure for 96 hours were studied on T sub 3 and T sub 4 concentrations in plasma, and in pharyngeal thyroid tissue preparations. Thyroid peroxidase (TPO) activity in the pharyngeal thyroid tissue, along with the extra-thyroidal conversion of T sub 4 into T sub 3 were measured in a freshwater catfish, Heteropneustes fossilis. BHC stimulated TPO activity in this fish, during both in vitro and in vivo studies. In contrast, malathion was found to stimulate TPO activity during the in vitro experiments but to inhibit it in the in vivo study. Concentrations of T sub 3 and T sub 4 increased in the thyroid gland, as well as in the plasma, in response to BHC exposure. However, in both these tissues, malathion increased T sub 3 concentrations and reduced T sub 4 concentrations. The extrathyroidal conversion of T sub 4 into T sub 3 was stimulated by malathion and inhibited by BHC. (Author's abstract)
W87-07118

INFLUENCE OF PH AND ALUMINUM ON DEVELOPING BROOK TROUT IN A LOW CALCIUM WATER,
Columbia National Fisheries Research Lab., MO.
J. B. Hunn, L. Cleveland, and E. E. Little.
Environmental Pollution, Vol. 43, No. 1, p 63-73, January 1987. 7 tab, 27 ref.

Descriptors: *Toxicity, *Acid rain, *Water pollution effects, *Hydrogen ion concentration, *Aluminum, *Fish physiology, *Lethal limit, *Trout, Mortality, Sublethal effects, Water softening, Fish behavior, Growth, Embryonic growth stage, Growth stages, Hatching, Larvae, Larval growth stage.

Eyed embryos of brook trout (Salvelinus fontinalis) were exposed to nominal pHs of 4.5, 5.5 and 7.5 with and without aluminum (300 micrograms/liter) in extremely soft water (hardness < 9 milligrams/liter) at 12 C. Embryo mortality exceeded 80% at pH 4.5, averaged 15 to 18% in the pH 5.5 treatments, and was less than 2% in the pH 7.5 treatments. Aluminum significantly reduced embryo mortality (85.3% versus 99.5%) at pH 4.5, but did not affect mortality at pH 5.5 or pH 7.5. Percent hatch and poor hatch were pH dependent and were not significantly influenced by aluminum. Brook trout larvae cumulative mortalities were 100% within 30 days at pH 4.5, with or without the aluminum; 69% after 60 days at pH 5.5; 100% in 15 days at pH 5.5 with aluminum and 20% after 60 days at 7.5 with or without aluminum. Fish that survived the pH 5.5 treatment showed decreased growth and behavioral impairments compared to the controls (pH 7.5 without aluminum). (Author's abstract)
W87-07119

ORGANOPHOSPHATE DICHLORVOS INDUCED DOSE-RELATED DIFFERENTIAL ALTERATIONS IN LIPID LEVELS AND LIPID PEROXIDATION IN VARIOUS REGIONS OF THE FISH BRAIN AND SPINAL CORD,
Jawaharlal Nehru Medical Coll., Aligarh (India). Interdisciplinary Brain Research Centre.
P. Vadhva, and M. Hasan.
Journal of Environmental Science and Health JPFCD2, Vol. 21, No. 5, p 413-424, October 1986. 5 tab, 18 ref. CSIR New Delhi, Research Grant 9 (155)83/EMR-II.

Descriptors: *Lipids, *Biological membranes, *Insecticides, *Water pollution effects, *Pesticides, Phosphates, Dichlorvos, Oxidation, Agricultural runoff, Fatty acids, Fish toxins, Bioaccumulation.

The effect of dichlorvos (DDVP) (o,o-dimethyl-2,2-dichlorovinyl phosphate) on various lipid fractions and on lipid peroxidation in the discrete areas of the brain and spinal cord were studied in the fresh water teleost (Heteropneustes fossilis) (Little information is available on dose-related changes in these values after DDVP intoxication.) Fishes were exposed to three different doses (3.0, 6.0, and 9.0 ppm) of DDVP daily for 7 days. (Author's abstract)
W87-07139

TOXICITY OF SOME RICEFIELD PESTICIDES TO THE CRAYFISH P. CLARKII UNDER LABORATORY AND FIELD CONDITIONS IN LAKE ALBUFERA (SPAIN),
Valencia Univ. (Spain). Dept. of Animal Physiology.
E. S. Andreu-Moliner, M. M. Almar, I. Legarra, and A. Nunez.
Journal of Environmental Science and Health JPFCD2, Vol. 21, No. 6, p 529-537, December 1986. 3 tab, 13 ref.

Descriptors: *Water pollution effects, *Insecticides, *Fungicides, *Herbicides, *Crayfish, *Toxicity, Lake Albufera, Rice, Lakes, Spain.

Static toxicities in mature crayfish (Procambarus clarkii) were determined for eight insecticides, two herbicides, and one fungicide which were frequently used in rice cultivation at Lake Albufera. It is necessary to perform a particular study of the effects of these chemicals as they relate to Lake Albufera since the environment and weather conditions are not comparable to those at the other sites at which studies of crayfish toxicity were made. Three concentrations of each product were used (1) the concentration recommended by the dealer (mg/L of active ingredient - Carbofuran 0.40, Carbaryl 0.80, Malathion 0.80, Trichlorfon 0.40, Endosulfan 0.56, Lindane 0.56, Fenithrothion 0.40, Cyfloxylate 0.02, Molinate-Thiobencarb 1.50, Copper Sulfate 0.42), (2) half the recommended concentration, and (3) double the recommended concentration. In all three concentrations tested, only Fenithrothion and Cyfloxylate caused a considerable mortality. The others produce no important effects on P. clarkii in our conditions. (Airone-PTT)
W87-07146

REVIEW OF SEDIMENT/WATER QUALITY INTERACTION WITH PARTICULAR REFERENCE TO THE VAAL RIVER SYSTEM,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5B.
W87-07150

RELATIONSHIP OF WATER QUALITY AND FISH OCCURRENCE TO SOILS AND GEOLOGY IN AN AREA OF HIGH HYDROGEN AND SULFATE ION DEPOSITION,
Pennsylvania State Univ., University Park.
W. E. Sharpe, V. G. Leibfried, W. G. Kimmel, and D. R. DeWalle.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 37-46, February 1987. 4 fig, 3 tab, 15 ref.

Descriptors: *Watersheds, *Fish populations, *Headwater streams, *Sulfates, *Acid rain, *Water pollution effects, *Ions, *Deposition, *Water quality, Pennsylvania, Trout, Streams, Alkalinity, Soil types, Geology, Acidification.

A survey of 61 headwater streams and their watersheds on Pennsylvania's Laurel Hill, an area of high hydrogen ion and sulfate deposition, was conducted in May and June 1983. Trout were absent from 12 or 20 percent of the streams. No fish were present in 10 streams. Thirty-three streams appeared to contain viable trout populations, 10 streams had other interfering cultural impacts and 6 streams had nonviable trout populations. Significant differences in water quality were noted among streams with and without fish. The streams having no fish as a group had significantly lower pH and alkalinity and higher dissolved aluminum than those with fish. Attempts were made to correlate soil type and geology with the presence or absence of trout. Watersheds with a major percentage of very stony land soil classifications always contained no trout or were culturally impacted. On the other hand, watersheds with a major percentage of Upshur (limestone derived) soils always supported trout. Watersheds with more than 30 percent Pocono Group bedrock supported trout in every case but two, while in every case but one, watersheds with more than 30 percent Pottsville Group bedrock did not support trout. Acid runoff episode data indicate severe transient acidification attributable to atmospheric deposition. It appears that a combination of very stony land, 30 percent Pottsville Group bedrock and high deposition of hydrogen ions and sulfate may result in transient acidification and absence of fish populations from headwater streams on Pennsylvania's Laurel Hill. (See also W87-07178) (Author's abstract)
W87-07179

HEMATOTOXIC EFFECTS OF 3,5-DINITRO-4-CHLORO-ALPHA,ALPHA,ALPHA-TRIFLUOROTOLUENE, A WATER CONTAMINANT,
Istituto Superiore di Sanita, Rome (Italy). Lab. di Tossicologia Comparata ed Ecotossicologia.
C. Guastadisegni, D. Hall, and A. Macri.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 105-109, October 1986. 2 tab, 10 ref.

Descriptors: *Water pollution effects, *Anemia, *Hematotoxicity, *Toxicity, Herbicides, *Trifluorotoluene, Organic compounds, Rats, Italy, Tissue analysis.

Three short-term studies of 7, 14, and 21 days, respectively, were made to investigate the nature of the anemia induced in rats by 3,5-dinitro-4-chloro-alpha,alpha,alpha-trifluorotoluene (DNCTT). This compound is an intermediate in the synthesis of dinitroaniline herbicides and was detected as a contaminant of a water-bearing stratum in northern Italy. DNCTT was mixed in a powdered rodent diet at a level of 2000 ppm and administered to Wistar-derived rats. DNCTT was shown to produce a hemolytic anemia of rapid onset; packed cell volume and hemoglobin concentration were decreased at all three treatment periods. Methemoglobin and reticulocyte count were increased compared to those of the control groups. Spleen enlargement was also evident at the macroscopic examination, whereas the liver appearance was normal. Pearl's Prussian blue staining performed on the spleen and liver was highly positive in the spleen of treated rats, but no iron deposition was detected in the liver of treated rats. (Author's abstract)
W87-07204

TOXICITY OF FOUR PESTICIDES ON THE FINGERLINGS OF INDIAN MAJOR CARPS LABEO ROHITA, CATLA CATLA, AND CIRRHINUS MRIGALA,
Government Motilal Science Coll., Bhopal (India). Dept. of Zoology.
S. K. Kulshrestha, N. Arora, and S. Sharma.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 114-119, October 1986. 4 fig, 2 tab, 8 ref.

Descriptors: *Water pollution effects, *Toxicity, *Pesticides, *Carp, Population exposure, Organic compounds, India, Life history studies, Fish physiology.

Fingerlings of Labeo rohita, Catla catla, and Cirrhinus mrigala were exposed to selected doses of four commonly used pesticides carbofuran, DDT, dimethoate, and Meta-Systox for a period up to 30 days to determine relative toxicological effects, LC50 values for 96 hr, maximum acceptable tolerant concentration, and application factor. The use of early life history tests has been emphasized for toxicological assessments. (Author's abstract)
W87-07205

COMPARATIVE KINETICS STUDY OF THE EVOLUTION OF FRESHWATER AQUATIC TOXICITY AND BIODEGRADABILITY OF LINEAR AND BRANCHED ALKYLBENZENE SULFONATES,
Rhone-Poulenc S.A., Paris (France).
A. Gard-Terech, and J. C. Palla.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 127-140, October 1986. 5 fig, 4 tab, 25 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Toxicity, *Biodegradation, *Alkylbenzene sulfonates, Surfactants, Detergents, Organic compounds, Daphnia, Zebra fish, Bacteria.

Evolution of both primary biodegradability and acute toxicity to daphnia and zebra fish of a linear alkylbenzene sodium sulfonate (LAS) and a branched alkylbenzene sodium sulfonate (BAS) were measured simultaneously. In six of eight experiments, LAS was biodegraded to 90% in 7 days and BAS to 70% in 7 days. In the two other experiments, both LAS and BAS have shown the same biodegradation speed and reached the same biodegradation level in 7 days: 45% in one experiment and 55% in the other. The composition of bacteria population and the level of cellular ATP of the inoculum play a decisive role in the biodegradation. These results confirm that it is essential to know the composition of bacteria population present in the inoculum as well as their biochemical characteristics to accurately interpret results of biodegradation tests. In the case of a rapid primary biodegradation of LAS and BAS, the acute toxicity of LAS remains three times as high as that of BAS for at least 24 hr toward daphnia and 48 hr toward zebra fish. Their acute toxicity to daphnia and zebra fish become equivalent only after 72 hr. When primary biodegradation of both products is slower, the acute toxicity of LAS remains higher than that of BAS for more than 7 days. (Author's abstract)
W87-07207

RELATIONSHIPS OF QUANTITATIVE STRUCTURE-ACTIVITY TO COMPARATIVE TOXICITY OF SELECTED PHENOLS IN THE PIMEPHALES PROMELAS AND TETRAHYMENA PYRIFORMIS TEST SYSTEMS,
Tennessee Univ., Knoxville. Coll. of Veterinary Medicine.
T. W. Schultz, G. W. Holcombe, and G. L. Phipps.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 146-153, October 1986. 3 fig, 1 tab, 15 ref.

Descriptors: *QSAR, *Toxicity, *Water pollution effects, *Phenols, *Minnows, *Tetrahymena, *Bioindicators, Comparison studies, Organic compounds, Regression analysis, Equations.

The relative toxic response of 27 selected phenols in the 96-hr acute flowthrough Pimephales promelas (fathead minnow) and the 48- to 60-hr chronic static Tetrahymena pyriformis (ciliate protozoan) test systems was evaluated. Log K sub ow-dependent linear regression analyses revealed that the data from each test system consisted of two linear equations. The less toxic chemicals form a relationship which models polar narcosis; these chemicals are slightly more active than the baseline toxicity of nonionic narcotic chemicals. The more toxic chemicals form a relationship which models uncoupling of oxidative phosphorylation. Regression analysis of fathead minnow toxicity (log LC50 (mol/liter)) vs Tetrahymena toxicity (log BR (mmol/liter)) showed good correlation between the two systems. An exception appears to be 4-nitrophenol, which is more active in the Tetrahymena system than in the fathead minnow and lies outside the 95% confidence interval. Reanalysis following deletion of 4-nitrophenol results in the equation log LC50 = -0.9192(log BR) - 3.5035; n = 26,r squared = 0.887. (Author's abstract)
W87-07208

EFFECT OF COMMERCIAL FORMULATION OF FOUR ORGANOPHOSPHORUS INSECTICIDES ON THE LH-INDUCED GERMINAL VESICLE BREAKDOWN IN THE OOCYTES OF A FRESHWATER TELEOST, MYSTUS VITTATUS (BLOCH)-A PRELIMINARY IN VITRO STUDY,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. Haider, and N. Upadhyaya.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 2, p 161-165, October 1986. 1 tab, 15 ref.

Descriptors: *Mystus, *Water pollution effects, *Organophosphorus pesticides, *Insecticides, Population exposure, Oocytes, Teleosts, Reproduction, Fish physiology, Organic compounds, Pesticides.

Effect of commercial formulation of four organophosphorus insecticides such as malathion, phosdrin (mevinphos), birlane (chlorfenvinphos), and gardona (tetrachlorvinphos) on LH-induced in vitro germinal vesicle breakdown (GVBD) in the oocytes of Mystus vittatus was investigated using three concentrations for each insecticide. All of these insecticides could significantly inhibit the LH-induced GVBD in all of their concentrations except two lower concentrations of birlane. A probable mechanism of inhibition of reproduction by these insecticides is discussed in the light of present findings. (Author's abstract)
W87-07209

ARSENIC, ANTIMONY AND SELENIUM SPECIATION DURING A SPRING PHYTOPLANKTON BLOOM IN A CLOSED EXPERIMENTAL ECOSYSTEM,
Southampton Univ. (England). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W87-07217

USE OF A SENSITIVE INDICATOR SPECIES IN THE ASSESSMENT OF BIOLOGICAL EFFECTS OF SEWAGE DISPOSAL IN FJORDS NEAR BERGEN, NORWAY,
Dunstaffnage Marine Research Lab., Oban (Scotland).
J. Blackstock, P. J. Johannessen, and T. H. Pearson.
Marine Biology MBIOAJ, Vol. 93, No. 2, p 315-322, November 1986. 3 fig, 2 tab, 40 ref.

Descriptors: *Bioindicators, *Glycera, *Sewage disposal, *Norway, *Water pollution effects, *Waste disposal, *Fjords, *Sediments, Polychaetes, Enzymes, Metabolism, Coastal waters, Biochemistry.

Coordinated environmental, ecological and biochemical studies were applied to assess the impact of sewage disposal in a fjordic system near Bergen, Norway. The ecological and biochemical effects were studied in 1983 at four sampling locations situated along a spatial gradient of effects of the sewage on conditions in the sediments. Two of the locations, near Dolviken, were found to be considerably affected by the sewage. Relatively few species of macrobenthic invertebrate fauna were present at these locations, and analysis of the distribution of individuals among species indicated distortion of the benthic community structure. On the basis of its distribution along spatial gradients of organic enrichment and various criteria relating to its suitability for biochemical analysis, the polychaete Glycera alba (Muller) was selected as the most suitable pollution-sensitive indicator species for use in the biochemical studies. In individuals from the two affected locations near Dolviken, maximal activities of the regulatory glycolytic enzyme, phosphofructokinase, and the pyruvate oxidoreductase, alanopine dehydrogenase, were very low. Activities of several other enzymes associated with carbohydrate catabolism were also lower in these groups than in the reference group collected from Raunefjorden. The ecological and biochemical measures both corresponded closely with the changes in environmental conditions along the gradient of sewage effects. The results are discussed with reference to earlier coordinated ecological and biochemical investigations carried out in Scotland and Norway and to experimental studies of the effects of pollutants and hypoxia on energy-yielding metabolism of polychaetes. It is suggested that the enzymatic changes in G. alba may be a sensitive component of an integrated metabolic response, which may involve a decrease in glycolytic energy production for the fuelling of muscular activity. Further development of this coordinated ecological and biochemical approach is discussed, with emphasis on its potential utility in the assessment of biological effects of the disposal of organically rich waste materials in coastal waters. (Author's abstract)
W87-07229

EFFECTS OF 9-10 DIHYDROANTHRACENE AND ITS BIODEGRADATION PRODUCTS ON THE MARINE DIATOM PHAEODACTYLUM TRICORNUTUM,
Centre d'Oceanologie de Marseille (France).
M. M. Goutx, M. Al-Mallah, and J. C. Bertrand.
Marine Biology MBIOAJ, Vol. 94, No. 1, p 111-115, February 1987. 4 fig, 1 tab, 29 ref. Elf Petroleum Co. Contract 5022.

Descriptors: *Water pollution effects, *Diatoms, *Biodegradation, *Aromatic hydrocarbons, *Dihydroanthracene, Population exposure, Growth, Photosynthesis, Chlorophyll a, Synergistic effects, Toxicity.

Growth, photosynthetic capacity and chlorophyll a content of the marine diatom Phaeodactylum tricornutum Bohlin were observed after exposure to the aromatic hydrocarbon 9-10 dihydroanthracene and its biodegradation products. Growth was inhibited after exposure to the aromatic hydrocarbon, whereas no inhibition occurred in the presence of the biodegradation products alone. The degradation products were found to enhance the chlorophyll a cellular content. Synergistic effects between dihydroanthracene and its biodegradation products increased the toxicity of this aromatic hydrocarbon. (Author's abstract)
W87-07230

ROLE AND NATURE OF ENVIRONMENTAL TESTING METHODS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
For primary bibliographic entry see Field 5A.
W87-07234

ACCUMULATION IN AQUATIC ORGANISMS,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-07240

MANAGEMENT OF TOXIC AND HAZARDOUS WASTES,
For primary bibliographic entry see Field 5E.
W87-07243

INFLUENCE OF HAZARDOUS AND TOXIC WASTES ON THE ENGINEERING BEHAVIOR OF SOILS,
Woodward-Clyde Consultants.
J. C. Evans, H. Y. Fang, and I. J. Kugelman.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 237-264, 4 fig, 2 tab, 25 ref. EPA Grant R810922.

Descriptors: *Soil water, *Soil properties, *Soil mechanics, *Water pollution effects, *Waste disposal, *Clays, Porosity, Gouy-Chapman model, *Model studies, Chemical reactions, Hazardous wastes.

It is evident that significant work has been done to provide an understanding of the interaction between pore fluids and clay behavior. This research has been conducted in various fields. Geotechnical engineers, in their effort to better understand the fundamentals of clay behavior, have conducted various tests utilizing alternate pore fluids and various clay minerals. Other researchers, looking for a practical application to the liner problems, have studied the effects of organic leachate on various soils used as liners. The findings of selected researchers have been reviewed on a case-by-case basis. The results were then examined for compatability with results predicted from the Gouy-Chapman model. In most cases the clay behavior due to changes in pore fluid composition were consistent with changes predicted by the use of the Guoy-Chapman model. The conclusion is drawn that the Gouy-Chapman theory may be useful as a predictive tool to study the influence of pore fluid on clay behavior. It is cautioned, however, that other phenomena (such as dissolution) may govern the clay response under certain chemistry conditions. To adequately work and understand these phenomena, a characterization of the waste is necessary. In a similar manner to geotechnical site characterizations, one must understand the general properties of the given waste and how those properties influence the clay behavior from a physical-chemical standpoint. It is recognized that considerable additional studies are required in virtually all areas of the effects of hazardous wastes on clays from a physical-chemical standpoint. The phenomena investigated here are extremely complex and all possible influences could not be addressed in this paper. Studies are required on the very basic levels of understanding clay mineralogy, pore fluid chemistry, and the interaction of a clay mineralogical system with pore fluids. Immediate needs are concerned with adequate and safe methods of conducting permeability tests with hazardous pore fluids on clay materials proposed for liners, which adequately reflect field conditions to which these clays will be subjected while in service. (See also W87-07243) (Lantz-PTT)
W87-07264

ENVIRONMENTAL RISK ASSESSMENT,
Risk Science International, Washington, DC.
L. M. Miller.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 367-371.

Descriptors: *Environmental effects, *Risk assessment, *Waste disposal, Industrial wastes, Legal aspects, Insurance.

Most companies that manufacture, handle or dispose of chemicals or petroleum products have the potential to cause environmental impairment, especially by long-term, or gradual release of materials into the environment. This impairment creates potential liabilities that result from numerous regulations as well as from common law. One way to identify these potential environmental liabilities and exposures is through environmental risk assessment. The primary focus of an environmental risk assessment is to evaluate the potential for off-site gradual impairment arising from a company's operations. Such an assessment reviews the status of the firm's environmental risk exposure, both as a snapshot of the present and as a review of past operations. In addition to being a useful internal tool for corporate planning, the assessment can also be used in obtaining environmental impairment liability (EIL) insurance, which provides coverage for gradual impairment that results in third-part bodily injury or property damage. (See also W87-07243) (Lantz-PTT)
W87-07274

TOXICOLOGY OF NATURAL AND MAN-MADE TOXICANTS IN DRINKING WATER,
Health Effects Research Lab., Cincinnati, OH.
R. J. Bull.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84-246255. Price codes: A02-PC in papercopy, A01-MF in microfiche. EPA Report No. EPA-600/D-84-222, September 1984. 14 p, 5 tab, 11 ref.

Descriptors: *Toxicity, *Drinking water, *Water pollution effects, *Water treatment, Organic carbon, Organic compounds, Trihalomethanes, Halocetonitriles, Carcinogens, Chemical analysis.

Drinking water obtained from surface sources contains a very large variety of organic chemicals. The total organic carbon present in the source water is made up of both natural and man-made chemicals. In most instances natural organic material predominates and is largely made up of humic and fulvic acids. The introduction of chlorine into drinking water results in the formation of a variety of by-products including the trihalomethanes, haloacetonitriles, halogenated aldehyde and halogenated ketone derivatives. Representatives of these classes of chemicals have been shown to be mutagenic and/or carcinogenic. More recent studies have shown that similar chemicals are formed upon direct administration of chlorine solutions to rate. Hypochlorite and monochloramine (a common alternative disinfectant to chlorine) have been shown to be capable of increasing the percent of structurally abnormal spermheads in mice at low doses (4 mg/kg/day for five days). Chlorine dioxide, a proposed alternative disinfectant, has been shown to produce decreases in plasma thyroxine levels at exposures of 100 mg ClO2/L of drinking water. It is unlikely that these effects can be attributed to direct effects of disinfectants since they are all extremely reactive molecules and would react freely with the great excess of organic material present in the gastrointestinal tract. It is more likely that these effects can be attributed to reaction products such as those which have been identified in drinking water and/or the stomach contents of experimental animals. Therefore, these data suggest that chemical interactions between a group of chemicals that have been generally regarded as safe (the disinfectants) and other chemi-

cals of a low level of intrinsic toxicity (humic acids, stomach contents) produce potentially hazardous products. (Author's abstract)
W87-07309

METHOD FOR RANKING BIOLOGICAL HABITATS IN OIL SPILL RESPONSE PLANNING AND IMPACT ASSESSMENT,
National Coastal Ecosystems Team, Slidell, LA.
For primary bibliographic entry see Field 5G.
W87-07310

MUTAGENIC PROPERTIES OF DRINKING WATER DISINFECTANTS AND BY-PRODUCTS,
Health Effects Research Lab., Cincinnati, OH.
J. R. Meier, and R. J. Bull.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84246321. EPA Report No. EPA-600/D-84-224, September 1984. 31 p, 5 fig, 6 tab, 27 ref.

Descriptors: *Drinking water, *Water treatment, *Water pollution effects, *Mutagens, Carcinogens, Water supply, Chlorination, Chemical analysis, In situ tests.

The identification of a number of mutagenic and carcinogenic chemicals in public water supplies has raised concern over potential genetic and carcinogenic hazards to the human population. There is growing evidence to indicate that these chemicals are produced during water chlorination, and consequently alternative strategies for water disinfection are being considered. Unfortunately, it is not known to what extent the mutagenic activity in chlorinated drinking water, and the associated potential health risks, are accounted for by chemicals identified thus far. Laboratories are exploring the use of humic acid for studying the mutagenic properties of chlorinated humic acids in the Ames test and include results from studies on the ability of chlorinated and non-chlorinated humic acids to induce sister chromatid exchange (SCE) in vitro and to produce spermhead abnormalities and micronuclei in bone marrow in mice in vivo. Since disinfectant chemicals are generally added at levels sufficient to produce disinfectant residuals during distribution, the concern over potential health risks arising from the use of disinfectants may extend to the disinfectants themselves, or to by-products formed in vivo. This notion is supported by results in bacterial assays which suggest that chlorine and monochloramine are capable of inducing DNA damage and causing mutation. In addition, halogenated organic compounds with known mutagenic and carcinogenic properties have been shown to be formed in vivo following oral dosing of rats with sodium hypochlorite. Because of these findings tests have been conducted on the mutagenic potential of various disinfectants in vivo by examining chromosomal damage in bone marrow and spermhead abnormalities in mice. Studies are also being conducted on the toxicological properties of drinking water samples prepared using alternative techniques for disinfection and post-disinfection treatment. Preliminary results on the mutagenic activities of these samples are discussed. (Author's abstract)
W87-07311

APPLICATION OF FISHERIES MANAGEMENT TECHNIQUES TO ASSESSING IMPACTS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 8I.
W87-07339

WASTES IN THE OCEAN, VOLUME 1: INDUSTRIAL AND SEWAGE WASTES IN THE OCEAN.
State Univ. of New York at Stony Brook.
For primary bibliographic entry see Field 5E.
W87-07396

SIMPLE MODELS OF WASTE DISPOSAL IN A GYRE CIRCULATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology and Physical Oceanography.
For primary bibliographic entry see Field 5E.
W87-07399

MICROBIAL COMMUNITIES IN SURFACE WATERS AT THE PUERTO RICO DUMPSITE,
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5E.
W87-07406

PHYTOPLANKTON: COMPARISON OF LABORATORY BIOASSAY AND FIELD MEASUREMENTS,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
L. S. Murphy, E. M. Haugen, and J. F. Brown.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 219-233, 5 fig, 3 tab, 27 ref. NOAA Grant NA 80 ADD-00033.

Descriptors: *Phytoplankton, *Water pollution effects, *Waste disposal, *Bioassay, *Puerto Rico, *Ocean dumping, Industrial wastes, Phytotoxicity, Chlorophyll, Dinoflagellates, Environmental effects.

A laboratory bioassay was developed to predict the effects on the phytoplankton community of the several wastes disposed of at deep-ocean dumpsites. The bioassay measured change in chlorophyll fluorescence and cell number of specified clones in a controlled environment. For all phytoplankton clones tested, the pharmaceutical and the American Cyanamid wastes were more toxic than the DuPont-Edge Moor waste, which was more toxic than the DuPont-Grasselli waste. Centric diatoms and dinoflagellates were more sensitive to the wastes than were pennate diatoms and some representatives of the monad classes, but some degree of resistance was shown in isolates of other classes established from polluted estuaries. These bioassays predict that changes in community structure should occur at the concentration existing in the wake of the barge during dumps. Initial studies at the Puerto Rico dumpsite showed an immediate, short-term pulse effect on the community structure, with dinoflagellates decreasing and monads increasing. (See also W87-07396) (Author's abstract)
W87-07407

COPEPODS AND ICHTHYOPLANKTON: LABORATORY STUDIES OF PHARMACEUTICAL WASTE TOXICITY,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
W. Y. Lee.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 235-250, 6 tab, 12 ref. NOAA Grant 04-8-M01-54.

Descriptors: *Water pollution effects, *Waste disposal, *Copepods, *Ichthyoplankton, *Ocean dumping, *Toxicity, Industrial wastes, Phytotoxicity, Redfish, Mortality, Environmental effects, Larvae, Population exposure.

Studies were carried out to determine the toxicity of six ocean-dumped pharmaceutical wastes to marine copepods and redfish (Sciaenops ocellata) eggs and larvae. To simulate waste concentrations at the dumpsite, copepods were consecutively immersed in a series of waste dilutions for intervals of 2 min to 2 hr: 2 min in 10% waste solution, 5 min in 1%, 1 hr in 0.1%, and 2 hr in 0.01%. Animals were then transferred to untreated seawater to determine the delayed mortality. Samples from Merck and Pfizer wastes were acutely toxic to marine copepods; mortality was > 35% at the end of 3 hr exposure. Capir, Squibb, and Upjohn wastes produced low initial mortalities but high delayed mortalities (> 60%). The ichthyoplankton were treated with the Capri, Squibb, and Bristol wastes. During the exposure, observations were made on hatching success of embryos and on morphological deformity, behavioral abnormality, and survival of larvae. Merck and Squibb wastes were acutely toxic to eggs and newly hatched larvae at concentrations of 0.5-1%. The corresponding toxic levels for Bristol waste were 0.07% for eggs and 0.045% for larvae. The higher toxicity of Bristol waste may have been caused by its major component, N,N-dimethylaniline, which is more persistent in the marine environment than other components in the wastes. (See also W87-07396) (Author's abstract)
W87-07408

FISH: RESPONSE TO OCEAN-DUMPED PHARMACEUTICAL WASTES,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
D. E. Wohlschlag, and F. R. Parker.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 251-270, 3 fig, 3 tab, 25 ref. NOAA Grant 04-8-M01-54.

Descriptors: *Fish physiology, *Ocean dumping, *Waste disposal, *Water pollution effects, Industrial wastes, Salinity, Toxicity, Fish, Population exposure.

Metabolic levels and swimming performances of Lutjanus campechanus (red snapper) at 20 C and a salinity of 35 parts per thousand in dilutions of a composite pharmaceutical waste indicated fatal toxicity for fish required to swim for 24 hr at a concentration of 0.25% (v/v) in seawater. For fish held two days at 0.25 and 0.0625%, both swimming performance and active metabolism dropped as waste concentration increased. Standard (maintenance) metabolism was fairly constant. Metabolic scope (the difference between active and standard metabolic rates) declined in proportion to the sublethal waste concentration for two-day exposures. Exposure-recovery experiments at 28 C and a salinity of 35 parts per thousand with Cynoscion nebulosus (spotted seatrout) were conducted with composite and six individual industry wastes. The first visible signs of stress appeared in 2 hr or less at concentrations between 0.5 and 0.00625%, depending on the initial toxicity of each waste source. When the fish were transferred to clean seawater the metabolic levels were highly variable. The standard metabolism always increased compared to controls, and swimming performance declined. The active metabolic levels did not decrease uniformly because of the stimulatory effects of the Upjohn waste and possibly of the Merck, Bristol, and Pfizer wastes. The metabolic scope, except in the Upjohn experiments, remained depressed at the end of the recovery period. The unusually great depression of scope in the composite experiment may have been caused by negative interactions among waste components. Signs of morbidity after a 2- to 4-day recovery indicated that initial exposure concentrations were too high and too long for complete recovery. The extent of cumulative or delayed lethality in ocean dumping needs to be investigated in terms of population suppression effects on fishes that may be exposed in short-term pulses of subacute toxic levels of wastes every few days. (See also W87-07396) (Author's abstract)
W87-07409

EFFECTS OF SEWAGE SLUDGE DUMPING ON CONTINENTAL SHELF BENTHOS,
Environmental Protection Agency, Annapolis, MD.
D. W. Lear, and M. L. O'Malley.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 293-311, 5 fig, 6 tab, 43 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Wastewater disposal, *Water pollution effects, *Sludge, *Ocean dumping, Lead, Copper, Organic carbon, Sediments, Swales, Polychaetes, Capitella capitata.

The fate and effects of the ocean dumping of sewage sludge at a mid-continental shelf dumpsite were studied by comparison of the defined area of

deposition with a reference area away from prevailing flows. Concentrations of lead, copper, and organic carbon, and the percentage fine sediment fraction (silts plus clays) were significantly greater in the dumpsite grid compared with the reference grid. Swales in the dumpsite grid were areas of highest concentrations of contaminants, and the pollution-sensitive ampeliscid amphipods were atypically absent from these sites. The pollution-tolerant polychaete Capitella capitata was found only in contaminated swales. This study identified at least one locus of pollution due to ocean dumping, and the biological response characteristic of such contamination. (See also W87-07396) (Author's abstract)
W87-07411

SEWAGE SLUDGE DUMPING IN THE MID-ATLANTIC BIGHT IN THE 1970S: SHORT-, INTERMEDIATE-, AND LONG-TERM EFFECTS,
Millersville State Coll., PA. Dept. of Earth Sciences.
B. L. Oostdam.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 313-335, 10 fig, 6 tab, 22 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Water pollution effects, *Ocean dumping, *Waste disposal, *Sludge, *Philadelphia, *Pennsylvania, *Delaware, *Maryland, Water columns, Thermocline, Aggregates, Clams, Environmental effects.

The fate of treated sewage sludge dumped by the City of Philadelphia off the coast of Delaware and Maryland was considered on short-, intermediate-, and long-term time scales. Short-term (minutes to hours) studies of the water column before, during, and after dumping operations show the importance of the thermocline both as a barrier to settling and as a surface enhancing dispersal. Intermediate-term (days to months) events indicate the importance of the net southward bottom drift to the dispersal of sewage sludge. A fine flocculent material consisting of natural aggregates, possibly mixed with settled sewage sludge, disperses widely. Long-term effects (>1 year) deal with the environmental changes at a newly established interim dumpsite and the recovery of an abandoned old dumpsite; attempts to evaluate these effects from a study of changes in trace element concentrations in sediments and in the surf clams, Spisula solidissima, were inconclusive. (See also W87-07396) (Author's abstract)
W87-07412

MARINE AMOEBAE (PROTOZOA: SARCODINA) AS INDICATORS OF HEALTHY OR IMPACTED SEDIMENTS IN THE NEW YORK BIGHT APEX,
National Marine Fisheries Service, Oxford, MD. Northeast Fisheries Center.
T. K. Sawyer, and S. M. Bodammer.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 337-352, 2 fig, 3 tab, 22 ref.

Descriptors: *Marine environment, *Water pollution effects, *Waste disposal, *Ocean dumping, *New York Bight, *Sediments, *Marin amoeba, *Bioindicators, Protozoa, Environmental effects, Dredging, Acids, Wastewater disposal, Marine sediments, Municipal wastes, Ecosystem, Sludge.

Thirty-two species of marine amoebae were identified from the northwest Atlantic Ocean in the New York Bight apex near active sewage, dredge, and acid-waste dumpsites. Twenty-seven of the 32 species were present in surface waters, 25 in bottom waters, and 20 in sediment core samples. Bottom cores from the sewage site yielded 11 of the 32 species, acid-waste cores 11, dredge spoil cores 9, and control station cores 13. Only 3 of the 32 species were present in cores from all of the collection sites: Paramoeba pemaquidensis, Clydonella vivax, and Platyamoeba langae. The recovery of the three species from all collection sites indicated that they might be useful indicators for monitoring ocean sediments for effects more serious than those brought about by existing disposal practices. The presence of 11 amoeba species from the New York sewage dumpsite, already depleted of most macrofaunal species, indicated that the polluted sediments still support microfaunal species which contribute to organic decay and nutrient regeneration. The 20 species present in sediments are bactivorous and thrive at the lowest level of the food web. Environmental modifications, which might disrupt protozoan/bacterial interactions in surficial sediments, can be measured qualitatively by monitoring the seabottom for changes in protozoan species diversity. Preliminary studies on species diversity showed that, when seabottom sediments were cultured on distilled water agar to test for physiologically adaptable species, well-known freshwater or bacteria. Sewage sites yielded species of Acanthoamoaeba from 20 to 80% of the sediment samples, and sites that were not affected by sewage sludge yielded the amoebae from 0 to 5% of the samples. (See also W87-07396) (Author's abstract)
W87-07413

NUTRIENT CYCLING BY WETLANDS AND POSSIBLE EFFECTS OF WATER LEVELS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W87-07436

CHANGES IN THE DISTRIBUTION PATTERNS OF TRACE METALS IN SEDIMENTS OF THE MERSEY ESTUARY IN THE LAST DECADE (1974-83),
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5B.
W87-07466

SEDIMENTS OF LAKE BALDEGG (SWITZERLAND) - SEDIMENTARY ENVIRONMENT AND DEVELOPMENT OF EUTROPHICATION FOR THE LAST 100 YEARS (DIE SEDIMENTE DES BALDEGGERSEES (SCHWEIZ) - ABLAGERUNGSRAUM UND EUTROPHIERUNGSENTWICKLUNG WAHREND DER LETZTEN 100 JAHRE),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geologisches Inst.
For primary bibliographic entry see Field 2H.
W87-07527

MICROBIAL ACTIVITY IN THE SURFICIAL SEDIMENTS OF AN OLIGOTROPHIC AND EUTROPHIC LAKE, WITH PARTICULAR REFERENCE TO DISSIMILATORY NITRATE REDUCTION,
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-07528

DETERIORATION OF MARBLE STRUCTURES: THE ROLE OF ACID RAIN,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
R. J. Cheng, J. R. Hwu, J. T. Kim, and S.-M. Leu.
Analytical Chemistry ANCHAM, Vol. 59, No. 2, p 104A-106A, January 15, 1987. 4 fig, 1 tab.

Descriptors: *Acid rain, *Weathering, *Marble, *Pollutant identification, *Air pollution effects, Rainfall, Air pollution, Gypsum, Sulfur compounds, Calcium carbonate, Fly ash, Industrial wastes, Metals, Catalysts, Oxidation.

Old marble structures are deteriorating at noticeable rates as the marble is converted to gypsum thereby weakening the structures. The acceleration in destruction has created an interest in discovering how the damage occurs and has generated concern about the role of acid rain in the destruction. Acid rain is caused by the emission of sulfur dioxide and nitric oxide which are converted to sulfates and nitrates, respectively, making rain acidic in character. The sulfates then convert the calcium carbonate, an insoluble component of marble, into the soluble gypsum. The nitrates convert the calcium carbonate into calcium nitrate. In order to slow the gypsum formation, the destructive material needed to be identified and its source determined. Modern optical and classical analytical techniques were used to show that it is the sulfates in acid rain that destroys marble. Using a scanning electron microscope and an energy-dispersive X-ray microanalyzer, it was found that fly ash emitted from industrial smokestacks was embedded in the marble along with the gypsum. Experiments were performed to show that fly ash, containing oxidized metals, acts as a catalyst for the oxidation of sulfur dioxide to sulfates which then causes the deterioration of the marble. (Wood-PTT)
W87-07533

CHEMICAL SPILL RAVAGES THE RHINE,
L. Pilarski, and R. Lewald.
Engineering News - Record ENREAU, Vol. 217, No. 21, p 12-13, November 1986.

Descriptors: *Rhine River, *Hazardous materials, *Water pollution, *Contamination, *Public policy, *Environmental protection, *Water pollution effects, Mercury, Heavy metals, Environmental effects, Legal aspects, Regulations, Cleanup, Decontamination, Environment, Aquatic environment, Disasters.

A fire at a Swiss warehouse that caused 10 to 30 tons of hazardous chemicals to flow into the Rhine has devastated aquatic life in the 185-mile stretch of the river between Basel, Switzerland and Mainz, West Germany. West European and Common Market officials have sharply rebuked the Swiss government and Sandoz AG, the firm that owns the complex, for not immediately announcing the spill and for delaying the release of detailed information on the chemicals involved. Swiss emergency planning, risk analysis, and warning systems have been criticized as inadequate. The spill is described as the worst contamination that has ever occurred in a larger European river. Phosphoric compounds reached levels of 100 micrograms per liter, and mercury exceeded levels of 1 microgram per liter near the Swiss border. Experts hope that the swift current in most parts of the German Rhine has prevented significant settlement of long-term deposits; however, deposits may be a long-term problem in Holland's sandy Rhine delta and the tidal flatlands of the North Sea. (Doria-PTT)
W87-07540

5D. Waste Treatment Processes

WOOD BLOCK MEDIA FOR ANAEROBIC FIXED BED REACTORS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
R. A. Nordstedt, and M. V. Thomas.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1990-1996, November-December 1985. 3 fig, 8 tab, 18 ref.

Descriptors: *Anaerobic reactors, *Wastewater treatment, *Wood block media, Animal wastes, Plastic media, Performance evaluation, Fatty acids, Distribution, Chemical oxygen demand, Costs, Methane.

Bench scale anaerobic fixed bed reactors containing oak, cypress and pine wood block media were operated at 31.1 C with hydraulic retention times as low as 2 days using supernatant from settled swine waste as feedstock. Similar reactors were operated using three types of commercially available plastic media and no media. All reactors had a fixed liquid or void volume of 5 L. The wood block media performed as well as plastic media and showed no visual signs of deterioration after one year of operation. Differences in volatile fatty acid levels and distributions suggested that start-up characteristics of wood block media may be better than those of plastic media. (Author's abstract)
W87-06671

EFFECT OF BIOMASS QUANTITY AND ACTIVITY ON TOC REMOVAL IN A FIXED-BED REACTOR,
Centre des Sciences de l'Environment, Metz (France).
N. Nouvion, J. C. Block, and G. M. Faup.
Water Research WATRAG, Vol. 21, No. 1, p 35-40, January 1987. 5 fig, 7 tab, 8 ref. Ministry of the Environment (France) Grant N.83-274.

Descriptors: *Wastewater treatment, *Upflow reactors, *Total organic carbon, *Biomass, Retention time, Process control, Carbon, Performance evaluation, Head loss, Enzymes.

Experimental runs were carried out on an upflow fixed-bed reactor. The process cycle of 24 h was determined by following head losses used as an indicator of the clogging of the filter. The efficiency with which dissolved carbon pollution is eliminated, measured by the percentage of TOC removal decreases over the 24 h due to a decrease of 30% of the retention time, while the specific dehydrogenase activities of the biomass stay constant along the process cycle. The 50% increase in volatile matters at the end of the cycle does not induce a corresponding increase in the efficiency. (Author's abstract)
W87-06752

USE OF LAB BATCH REACTORS TO MODEL BIOKINETICS,
A. Braha, and F. Hafner.
Water Research WATRAG, Vol. 21, No. 1, p 73-81, January 1987. 11 fig, 3 tab, 17 ref.

Descriptors: *Batch cultures, *Wastewater treatment, *Biological wastewater treatment, *Model studies, *Biokinetics, *Batch reactors, *Wastewater treatment, *Biomass, *Kinetics, Substrates, Cultures, Activated sludge, Performance evaluation.

Compared to the continuous-culture normally applied for investigating the elimination behavior of a multi component-substrate usually present in waste waters, the use of batch-cultures represents a much easier procedure and furnishes a considerable reduction of operation and time expenditure. However, the main disadvantage of such batch-cultures is their functioning under transient-state conditions. The consequences are mathematical difficulties as to accurate evaluation of the biokinetic constants Y, K sub s and mu sub max. On the one hand the active biomass produced during the removal process immediately is also taking part in the reaction development; on the other hand the nature of remaining substrate compounds in the mixed liquor is changing during the process. Thus, the biological removal process in batch reactors is rather complicated and for its mathematical analysis certain simplification had to be effected. Therefore, the applicability of an integral solution to model the substrate removal process was analyzed by seven batch tests with adapted activated sludge. As these tests show it is possible to determine Y, K sub s and mu sub max accurately via one single batch test run, thus mathematically eliminating any effects of the varying nature of the rest-substrate composition and changing active biomass/MLVSS ratio during the batch process development on the kinetics of the substrate removal process. (Alexander-PTT)
W87-06757

ALTERATION OF THE AEROBIC- AND FACULTATIVE ANAEROBIC BACTERIAL FLORA OF THE A/B PURIFICATION PROCESS CAUSED BY LIMITED OXYGEN SUPPLY,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
J. Antheunisse, and J. I. A. Koene.
Water Research WATRAG, Vol. 21, No. 1, p 129-131, January 1987. 2 tab, 11 ref.

Descriptors: *Anaerobic bacteria, *Wastewater treatment, *Aerobic absorption, *Species composition, *Oxygen supply, Limiting nutrients, Nutrients, Oxygen, Absorption, Bacteria, Domestic wastewater.

The bacterial flora of the aerated adsorption phase of an imitated A/B purification process of unsettled waste water was estimated. In sequence of importance, microorganisms of the following genera or groups were identified: Pseudomonas, Acinetobacter, Aeromonas, Corynebacterium, Flavobacterium and yeast-likes. Moraxella, Streptococcus, Escherichia, and Enterobacter or related genera were scarcely present. During a 5 day period of very low oxygen supply the number of Acinetobacter strains in particular increased from 14 to 55%. This high percentage of Acinetobacter decreased when oxygen was present in sufficient amounts. (Author's abstract)
W87-06764

PERFORMANCE OF THE DUCKWEED SPECIES LEMNA GIBBA ON MUNICIPAL WASTEWATER FOR EFFLUENT RENOVATION AND PROTEIN PRODUCTION,
California State Univ., Fresno. Center for Irrigation Technology.
G. Oron, D. Porath, and H. Jansen.
Biotechnology and Bioengineering BIBIAU, Vol. 29, No. 2, p 258-268, February 1987. 10 fig, 7 tab, 26 ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Duckweed, *Performance evaluation, *Effluents, *Wastewater renovation, Proteins, Wastewater, Ponds, Irrigation, Wastewater irrigation, Water reuse, Organic loading, Waste load, Ammonia, Water quality standards, Mathematical equations, Bioaccumulation, Crop yield.

An outdoor experiment was conducted in miniponds to evaluate the performance of Lemna gibba, a duckweed species, as a domestic wastewater stripper. Duckweed is one of the floating plants with a high capability of ammonia uptake and assimilation rate into valuable protein. The results indicate that under adequate operational conditions, depending mainly on the organic loading, the effluent meets irrigation reuse criteria and protein yield of the duckweed may reach 12 ton/ha per year, far above other conventional field crops. (Author's abstract)
W87-06784

MODELING BISUBSTRATE REMOVAL BY BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-06785

STUDY ON THE TREATMENT OF WASTEWATER GENERATED AT KSC STS OPERATIONS AND PROJECTED EFFECTS ON THE DESIGN OF THE STS HAZARDOUS WASTE MANAGEMENT FACILITY AT VANDENBERG AFB, CALIFORNIA.
Fluor Engineers and Constructors, Inc., Irvine, CA.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as AD-A144 420, Price codes: A11 in paper copy, A01 in microfiche. Air Force Report No. SD-TR-84-08, October 1983. 244 p, 18 fig, 19 tab, 11 ref, 9 append.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Waste management, *Vandenberg Air Force Base, *California, Wash water, Chemical precipitation, Filtration, Reverse osmosis, Water reuse.

The Space Shuttle launching at Vandenberg AFB is expected to deposit corrosive materials on the launch support facilities. These materials will be washed and the contaminated wash water collected and treated. The treatment process consists of a precipitation step where the metal cations are removed from the contaminated water. The clarified water is filtered and passed through reverse osmosis membranes where the inorganic salts are reduced to a level satisfactory for the water to be recycled for reuse in a subsequent launch. The solid residue is disposed of at a landfill and the reject brine water is evaporated in a solute pond. The design criteria for the project were based on measurement data obtained at Kennedy Space Center. A treatment process developed commercially is recommended. It is also recommended that leachate tests be conducted on the sludge filter cake. If no hazardsous leachate is detected, there would be an appreciable cost savings in disposing of the filter cake in a sanitary landfill without having to contain it first in lined, sealed drums. (Lantz-PTT)
W87-06846

WATER MANAGEMENT AND REUSE OF COAL CONVERSION PROCESS CONDENSATES,
Carnegie-Mellon Univ., Pittsburgh, PA.
For primary bibliographic entry see Field 3C.
W87-06928

LOW-COST WATER SUPPLY AND SANITATION TECHNOLOGY: POLLUTION AND HEALTH PROBLEMS.
World Health Organization, New Delhi (India). Regional Office for South-East Asia.
South-East Asia Regional Health Papers No. 4, 1984. 40 p, 6 fig, append.

Descriptors: *Water supply development, *Water reuse, *Economic aspects, *India, *Indonesia, *China, Water treatment facilities, Cost analysis, Rural areas.

Simple, low-cost technologies have been used in South-East Asia for a long time, particularly in the provision of water supplies to rural communities. Several applications have also been designed for excreta disposal. However, over the last few years governments and public authorities have begun to consider their use not only in rural but in urban areas as well. Such technologies could accelerate the coverage of unserved and underserved populations. With the efforts of various governments, UNICEF, WHO, World Bank and other international and bilateral agencies, demonstrations and field studies have been carried out, guidelines for design and operation developed, and schemes prepared for application. In India, schemes for providing nearly 200 towns with low-cost sanitation facilities are under preparation. In Indonesia and Thailand, projects are under way for providing hundreds of rainwater storage systems. Over 3,000,000 hand pumps are in use in the countries of this region. In China, over 7,000,000 biogas digesters are in operation; India has over 70,000. Their low per-capita cost and simplicity of operation have made these technologies irresistible. Many have proved to be socially acceptable and economically viable and, therefore, have come to be called 'appropriate technologies'. As with all technologies, however, their health implications must be given careful consideration. Being simple, and generally implemented on an individual basis, they are apt to be poorly conceived, constructed and maintained. Simplicity can breed complacency, with the result that the full health benefits implied in a wider coverage of rural and urban populations may not accrue. After all, the provision of water and sanitation has a dual purpose - improved environmental health and public convenience. Equal attention should be paid to both aspects. (Lantz-PTT)
W87-06937

EFFECT OF POWDERED ACTIVATED CARBON ON THE BIODEGRADATION OF BENZENE,
Texas Univ. at Austin. Center for Research in Water Resources.
D. A. Allen, and E. F. Gloyna.
CRWR Paper 178, December 1980. Technical Report. 65 p, 17 fig, 6 tab, 37 ref, 5 append.

Descriptors: *Wastewater treatment, *Activated carbon, *Biodegradation, *Benzene, Biomass, Total oxygen, Carbon, Microbiological studies, Suspended solids, Oxidation, Model studies, Sorption.

The effect of powdered activated carbon (PAC) on the biodegradation of benzene was studies to

evaluate the sorptive characteristics of biomass for benzene. Measurements of oxygen uptake by microorganisms utilizing benzene as a sole source of carbon were made. Various concentrations of PAC were used and each test was conducted using a selected food to microorganism ratio (F/M), based on the theoretical oxygen demand (TOD) of the benzene substrate, the mixed liquor volatile suspended solids (MLVSS) concentration, and a detention time of one day. Completely mixed cultures of aerobic/facultative organisms, acclimated in a bench-scale unit, were injected into Warburg reaction flasks, containing the benzene substrate and PAC. Purge and trap analytical techniques were used to evaluate sorption of benzene onto the biomass. Inactivated microorganisms mixed with various concentrations of benzene provided the basis for the sorption evaluations. PAC provided an optimum benzene concentration for microbial oxidation to proceed, although the overall effect was small. The oxidation of benzene by acclimated organisms was upward of 90% of the theoretical oxygen demand and sorption of benzene onto biomass appeared to follow Langmuir's model. (Author's abstract)
W87-06938

COMPUTERIZATION IN THE WATER AND WASTEWATER FIELDS.
Lewis Publishers, Inc., Chelsea, Michigan. 1986. 154 p. Edited by Eugene A. Glysson, Eric J. Way, Richard W. Force, and Wayne H. Abbott.

Descriptors: *Computers, *Water treatment, *Wastewater treatment, Water treatment facilities, Wastewater facilities, Automation, Economic aspects, Design criteria, Utilities.

There are many ways that a microcomputer may be useful in the water and wastewater fields. This book is intended to provide information leading to a better understanding of the computer itself and to show how it can be effectively and efficiently used in both large and small plants. The book is intended to be of interest to anyone who wishes to employ this modern data handling device. Contents of the text include a discussion of the selection of microcomputer and its software from a user's standpoint. Microcomputers are finding an increasing role in the operation of water and wastewater plants. Their typical initial uses are in word processing, report writing, correspondence, inventory control, and general bookkeeping functions. However, they can be used for acquiring signals, monitoring certain conditions in a plant, and taking action based on the signals received. This book includes the application of very simple and basic examples of transmitting input signals to a variety of low-cost microcomputers. These applications can be utilized by both water and wastewater facilities of both large and small capacities. There are many other uses of the microcomputer in the water and wastewater fields addressed in this volume. Included are: (1) utility rate studies; (2) water and sewer network analysis; and (3) mapping and design. The optimization of power utilization lends itself to computer analysis and control, resulting in a reduction of energy consumption at both large and small plants. Computer methods of revising plant operations to achieve an optimum utility bill are discussed. (See also W87-06966 thru W87-06978) (Lantz-PTT)
W87-06965

OPERATIONS CONTROL USING MICROCOMPUTERS,
Michigan Univ., Ann Arbor. School of Public Health.
R. A. Deininger.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 35-43, 12 fig.

Descriptors: *Process control, *Computers, *Operating policies, *Wastewater treatment, *Water treatment, Computer programs, Data acquisition, Water management.

Microcomputers are becoming so inexpensive and ubiquitous that in the near future, no water or wastewater treatment plant will be without this equipment. The range of computers is very wide, from the inexpensive Commodore computers to the top of the line IBM PC AT computer. There are many uses for microcomputers. Spreadsheets are of great utility in organizing storage, retrieval, and editing of the many data originating in a plant, and are ideally suited for summarizing the data in monthly or annual operating reports. The major emphasis of this chapter is the use of microcomputers to acquire signals from instruments, record the data, and take action based on the signals received. (See also W87-06965) (Lantz-PTT)
W87-06969

USING COMPUTERS FOR PROCESS CONTROL AT SMALL TREATMENT PLANTS,
Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
P. Loud.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 45-52, 2 fig, 3 tab.

Descriptors: *Computers, *Process control, *Water treatment facilities, *Wastewater facilities, *Computer programs, Wastewater treatment, Water treatment, Data collection, Optimization, Databases.

Prior to the advent of the microcomputer, computer systems installed in municipal facilities were commonly equipped with customized software specifically designed for that facility and its operation. These systems often were accompanied by a large price tag. The popularity of personal microcomputers on the other hand has opened up a competitive market for generic software which can be used by different types of facilities to improve recordkeeping and operational efficiency. Addressed here are those readily available types of software applicable to process analysis and control of small water and wastewater facilities. Emphasis is placed on the utilization of software which is relatively inexpensive and 'user friendly'. There are many applications in treatment plant process analysis for the use of standardized software products. These products generally include graphics programs, spreadsheets, data base management, word processing and communication software. Typical applications include data collection, trend analysis, process optimization, report generation, training and remote database acquisition. The use of a microcomputer can be initiated by the staff of small facilities without the immediate need for custom software or expensive hardware capabilities. (See also W87-06965) (Lantz-PTT)
W87-06970

USING COMPUTERS FOR PROCESS CONTROL AT LARGE TREATMENT PLANTS,
McNamee, Porter and Seeley, Ann Arbor, MI.
D. C. Mohler.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 53-66, 4 fig.

Descriptors: *Computers, *Process control, *Wastewater facilities, *Water treatment facilities, Wastewater treatment, Analog computers, Digital computers, Wastewater management, Operations control.

Certain basic functions must be carried out in any design regardless of how a control system is implemented. These include the following: (1) measurement; (2) process control; (3) operator information; and (4) management information. Analog systems and computer-based systems carry out the same functions though the methods employed differ. Indeed, the analog instrument-based systems involve the use of analog computers (controllers) to solve the valve positioning problem. The digital process computer does exactly the same thing, but the problem is solved numerically. The analog approach has an advantage in that the failure of a controller usually affects only the control loop in which it is involved. A cascade effect, however, may allow the failure of a critical controller at the head of a plant to adversely affect processes downstream. The typical process computer handles from eight to several dozen control loops: thus, the failure of a process computer has a more dramatic effect. However, current computer technology renders such machines extremely reliable, especially when dual redundant designs are employed. Fault tolerant and continuous uptime machines are becoming common in the process control industry. Computerization brings several clear benefits to the management of wastewater and water treatment plants: changes in process technology are easy to accomodate; plant wiring costs can be significantly reduced during construction; large fixed-function control panels can be avoided; process information is quickly available to operators and managers; and plant operating cost can be minimized through the use of more sophisticated process models. (See also W87-06965) (Lantz-PTT)
W87-06971

POWER USAGE OPTIMIZATION AND CONTROL BY COMPUTER,
McNamee, Porter and Seeley, Ann Arbor, MI.
T. S. Ritter.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 117-133, 9 fig.

Descriptors: *Optimization, *Computers, *Wastewater treatment, *Water treatment, *Energy, *Electric power rates, *Economic efficiency, Computer programs, Utilities, User charges.

Clean water, like most benefits of civilization and technology, uses energy - and costs money. The more sophisticated the methods of treating water and wastewater, the greater the consumption of electrical energy becomes. This higher usage of electrical power, and its increased cost per unit, have brought about an increasing effort to control the use of this resource. Some of the water and wastewater processes can be very energy intensive in one location, like high service pumping or secondary aeration. Other uses of energy are smaller but spread out geographically in equalization, filtration, settling basins and, in remote pumping locations. The sophistication of control for each operation depends on the type of operation. Simple pumping operations have pumps that may respond to float switches or pressure switches. Filtering operations require more sophistication whether backwashing is done manually or automatically. Described is a computer-based controller that can perform both the most mundane control as well as the most sophisticated. When it is part of a distributed control scheme, it communicates with other computers over a twisted pair of wires. What is of interest today, is how to use this computerized controller to control the electrical energy used in plants. In order to do that, the atypical utility charges for energy use is discussed. Once the utility rate structure is understood, the minimization of cost can be exploited with the capability of the computer controller to control remote loads economically, and provide sophisticated control for an energy intensive process. (See also W87-06965) (Lantz-PTT)
W87-06976

OPERATION AND MAINTENANCE USING A COMPUTER IN A SMALL PLANT,
W. R. Gramlich.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 135-138.

Descriptors: *Automation, *Wastewater facilities, *Computers, *Case studies, Process control, Computer programs, Performance evaluation, Wastewater treatment.

Operation and maintenance of the St. John's Wastewater Treatment Plant incorporates a wide variety of tasks. Reviewing and analyzing these activities revealed their suitability as computer applications. Purchase of hardware and software was initiated and justified on the premise that overall operation and maintenance efficiency and effectiveness would benefit. During the first year, however, accomplishments were mixed with disap-

pointments. While quantitative assessment is difficult, qualitatively it was a success. Reviewed are the applications and experiences of a small plant during its first year of using a computer. (See also W87-06965) (Lantz-PTT)
W87-06977

REALITIES OF COMPUTERIZING MAINTENANCE ACTIVITIES AT THE DETROIT WASTEWATER PLANT,
Detroit Wastewater Plant, MI.
H. W. Bierig, T. W. Roe, and D. A. Stickel.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 139-152.

Descriptors: *Computers, *Wastewater facilities, *Maintenance, *Automation, *Detroit, *Michigan, *Case studies, Wastewater treatment, Computer programs, Communication, Organizations, Personnel, Wastewater management.

The Detroit Wastewater Plant serves the city of Detroit and 76 suburban communities. The population served is three million persons. Average flow to the plant is 700 million gallons per day from residential, industrial and commercial sources. Rainfall and snowmelt from much of the service area also is conveyed to the plant, and can raise inflow to the plant to 1.2 billion gallons per day. The plant consists of primary and secondary treatment, with dewatering and incineration of the resulting sludge. The amount of sludge disposed of each day averages 2,400 wet tons. The plant occupies 123 acres and is the largest single plant in the country. Computerizing this facility is discussed with emphasis on: (1) communication, (2) organization, (3) spare parts, (4) training, (5) management support, (6) hardware, (7) software, and (8) implementation. (See also W87-06965) (Lantz-PTT)
W87-06978

USE OF SHORT-TERM BIOASSAYS TO EVALUATE ENVIRONMENTAL IMPACT OF LAND TREATMENT OF HAZARDOUS INDUSTRIAL WASTE,
Texas Agricultural Experiment Station, College Station.
For primary bibliographic entry see Field 5C.
W87-07003

TECHNICAL SUMMARY OF THE A/M AREA GROUNDWATER (AMGW) REMEDIAL ACTION PROGRAM,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5G.
W87-07013

WASTEWATER TREATMENT ACQUISITION STRATEGY FOR TEXAS COMMUNITIES,
Texas Dept. of Water Resources, Austin.
S. M. Bell, and N. E. Armstrong.
University of Texas, Austin, Center for Research in Water Resources, Technical Report No. CRWR-206, October 1983. 99 p, 5 fig, 31 tab, 25 ref.

Descriptors: *Wastewater treatment, *Texas, *Benefits, *Wastewater facilities, *Financing, Cost analysis, Public policy.

The benefits of wastewater treatment are generally well recognized within a community; however, the available means or programs by which wastewater facilities may be acquired in Texas are not as widely understood. The objective of this research is the development of program selection guidance for maximizing community benefits. The guidance consists of a presentation of project components and relationships with which the community may formulate analogies by self comparison and determine its optimum wastewater treatment acquisition strategy. Subjects include: available wastewater acquisition programs, typical project features, community project costs, project feature/costs relationships, and community optimum strategy. The available wastewater acquisition programs under review include the: (1) self-financed, (2) state loan, and (3) EPA grant programs. Current and proposed rules and regulations governing these three programs are utilized in conjunction with previous project data to develop and analyze 'typical' project groups of varying magnitudes and type. The typical project groups are based on design year populations or whether a treatment system existed previously. Typical project features analyzed with respect to these project groups include wastewater treatment needs, design capacities, and project performance times. These project features, in combination with the program rules and regulations, allow estimation of project costs under each acquisition program. Historical project costs, current economic variables, and the funding rules of each acquisition program are utilized to determine the community share of costs for typical projects of 10-year and 20-year designs under each acquisition program. An analysis of these costs can be utilized to identify the most cost-effective acquisition program for the community. A comparison of typical project features to typical project costs reveals feature-cost relationships which an atypical community can use to estimate atypical community project costs for comparison of the wastewater acquisition programs. Based upon the knowledge of community objectives and capabilities, the acquisition programs, and the interactions of project features and costs, an optimizing strategy for wastewater treatment acquisition by Texas communities is recommended. (Lantz-PTT)
W87-07020

SODIUM THIOSULFATE WASTEWATER TREATMENT IN ACTIVATED SLUDGE SYSTEMS,
Texas Univ. at Austin. Center for Research in Water Resources.
E. F. de Millano, C. A. Sorber, and E. F. Gloyna.
Technical Report No. CRWR-204, May 1983. 103 p, 10 fig, 24 tab, 77 ref, append.

Descriptors: *Wastewater treatment, *Sodium thiosulfate, *Biological wastewater treatment, *Activated sludge process, Biological oxidation, Hydrogen ion concentration, Nitrification, Bulking sludge, Bacteria, Sulfur compounds.

The simultaneous biological oxidation of thiosulfate and organic carbon in activated sludge units was studied. The effects of hydraulic detention time, pH, nitrogen and phosphorus concentrations and food to microorganism ratio on the production of elemental sulfur were evaluated. Identification of the thiosulfate-oxidizing bacteria was undertaken. In addition, the effects of the biological oxidation of thiosulfate on nitrification and sludge bulking and the chemical stability of thiosulfate at various pH values were studied. The thiosulfate food to microorganism ratio was the only parameter found to significantly influence the production of elemental sulfur and the conversion of thiosulfate to sulfate. Thiosulfate food to microorganism ratios below 0.53 mg of thiosulfate as sulfur/day/mg of mixed liquor volatile suspended solids were found to produce low elemental sulfur concentrations and high conversions of thiosulfate to sulfate. The biological oxidation of thiosulfate did not affect nitrification or sludge bulking. Apparently, the sludge settleability depended only on the organic food to microorganism ratio. Thiosulfate-oxidizing bacteria of the genus Thiobacillus were found to be present in the reactors with a concentration in the order of one million bacteria/mL of mixed liquor. Thiosulfate in the synthetic feed was found to be chemically stable when aerated for 24 hours between pH=5.6 and pH=7.9. Without aeration and after standing for 24 hours, thiosulfate was found to begin decomposing below pH=4.9. Sulfite and elemental sulfur were some of the sulfur compounds formed by acid decomposition of thiosulfate. (Lantz-PTT)
W87-07021

SRP GROUNDWATER PROTECTION IMPLEMENTATION PLAN, (DRAFT),
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5G.
W87-07025

NOTATION FOR USE IN THE DESCRIPTION OF WASTEWATER TREATMENT PROCESSES,
P. Grau, P. M. Sutton, M. Henze, S. Elmaleh, and C. P. Grady.
Water Research WATRAG, Vol. 21, No. 2, p 135-139, February 1987.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Notation, *Literature reviews, Publication, Standardization.

In 1980 a Working Group was set up by the International Association on Water Pollution Research and Control (IAWPRC) and the Commission on Water Quality of the International Union of Pure and Applied Chemistry (IUPAC) to prepare a proposal for unifying notation used in the description of biological wastewater treatment processes. This action was motivated by the benefits that would result from the adoption of a common system of notation in the dissemination of results in international publications. For this purpose the Working Group reviewed journals and books within the English, French, German and American literature in order to establish the quantities most often symbolized and to determine the symbols most commonly used to denote these quantities. By making use of established practice and common acceptance of recognized symbols it was hoped to gain the support of authors in the adoption of a unified system of notation. The recommendations of the report were accepted by the International Association on Water Pollution Research and Control and the International Union of Pure and Applied Chemistry. The report was widely circulated to professional societies and interested authors throughout the world in order to obtain the views of all organizations and individuals on the recommended standard system of notation. Since its publication, comments have been received from many authors acknowledging that the system would be of value in preparing their own papers and interpreting the papers of others. Although it was originally intended that a period of 1-yr should be allowed to obtain such views, this period did not allow sufficient time for authors to become familiar with the notation system through actual usage in preparing technical articles and consequently the time frame was extended. Specific changes to the notation were recommended by a number of reviewers. These recommendations were considered collectively by the Working Group and resulted in the revised standard notation system which follows. This revised system is likely to be modified again at some future date to reflect new concepts, processes, and required symbols, as well as new views and opinions of authors. (Alexander-PTT)
W87-07047

BIOLOGICAL SULPHATE REMOVAL FROM INDUSTRIAL EFFLUENT IN AN UPFLOW PACKED BED REACTOR,
National Inst. for Water Research, Pretoria (South Africa).
J. P. Maree, and W. F. Strydom.
Water Research WATRAG, Vol. 21, No. 2, p 141-146, February 1987. 6 fig, 3 tab, 11 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Sulfate-reducing bacteria, *Sulfur compounds, *Anaerobic digestion, Bacteria, Carbonates, Kinetics, Molasses.

A biological process for the removal of sulfate, using molasses as organic carbon source, is described. Sulfate is converted to sulfur via sulfide, and molasses to bicarbonate. Sulfate reducing bacteria are responsible for the reduction of sulfate to sulfide, while photosynthetic sulfur bacteria oxidize sulfide to elemental sulfur. It has been shown that these bacteria can live symbiotically in an upflow anaerobic packed bed reactor. The process is accompanied by the precipitation of calcium carbonate and heavy metal sulfides. Sulfate reduction follows zero order kinetics with respect to both reactants and products. The reduction of 1 g sulfate consumes 1.2 ml molasses and requires 6 h for completion. The optimum temperature for sul-

fate reduction was found to be 31 C. (Author's abstract)
W87-07048

BEHAVIOUR OF BIOLOGICAL REACTORS IN THE PRESENCE OF TOXIC COMPOUNDS,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski.
Water Research WATRAG, Vol. 21, No. 2, p 147-153, February 1987. 4 fig, 1 tab, 3 ref. Polish Academy of Sciences Research program 10.2.

Descriptors: *Model studies, *Toxicity, *Wastewater treatment, *Biological wastewater treatment, *Inhibition, Denitrification, Chromium, Heavy metals, Prediction.

A model of the influence of toxic compounds on the biological processes in waste water treatment reactors was developed. The model predicts the behavior of reactors influenced by toxic compounds acting as non-competitive inhibitors. The effects of a toxic compound on a process is quantified in terms of the inhibition coefficient K sub i for the compound and the reactor resistance to inhibition values. The proposed model was utilized for the analysis of data obtained in a packed bed reactor for denitrification in the presence of chromium Cr(6+). The inhibition coefficient for chromium was found to be 1.2 mg/L Cr(6+) and the reactor resistance to inhibition was 2.9 mg/L Cr(6+). (Author's abstract)
W87-07049

REMOVAL OF INDIGENOUS ROTAVIRUSES DURING PRIMARY SETTLING AND ACTIVATED-SLUDGE TREATMENT OF RAW SEWAGE,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
V. C. Rao, T. G. Metcalf, and J. L. Melnick.
Water Research WATRAG, Vol. 21, No. 2, p 171-177, February 1987. 1 fig, 7 tab, 26 ref.

Descriptors: *Wastewater treatment, *Virus removal, *Activated sludge, *Primary settling, Effluents, Chlorination, Cultures.

An eight month study of indigenous rotavirus removal during primary settling and activated sludge treatment of raw sewage was made in a plant in Houston, Texas treating 1.5 million gal/day. An average reduction of 44-55% was obtained by primary settling and a 93-99% reduction was achieved in final chlorinated effluents. Composite sampling at 1 h intervals over a 24 h period indicated average removals of 85% compared to a misleading 6% indicated by one set of grab samples of raw sewage and effluent collected simultaneously. Quantification of rotaviruses was made by immunofluorescent foci counts 24 h after addition of sample concentrates to coverslip cultures of fetal rhesus kidney cells. Rotaviruses varied from 40-510/l of raw sewage and from 0 to 25 in the final chlorinated effluent. (Author's abstract)
W87-07052

EFFECTS OF INHIBITORS ON NITRIFICATION IN A PACKED-BED BIOLOGICAL FLOW REACTOR,
University of Petroleum and Minerals, Dharan (Saudi Arabia). Dept. of Chemical Engineering.
S. A. Beg, and M. M. Hassan.
Water Research WATRAG, Vol. 21, No. 2, p 191-198, February 1987. 11 fig, 1 tab, 38 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Inhibition, *Nitrification, *Heavy metals, Arsenic, Chromium, Fluorides, Metals, Ions.

The individual effect of trivalent arsenic, hexavalent chromium and fluoride on nitrification is studied under continuous load in a packed bed biological flow reactor. The results show that Michaelis-Menten rate expression gives the best representation of nitrification data in the absence of inhibitors. However, in the presence of inhibitors, the system follows a non-competitive mode of inhibition with the following rate expression: alpha sub i = (V sub max S/K sub s + S)(K sub i/K sub i + I). The values of V sub max and K sub s are estimated as 1.466 mg/l/min for hexavalent chromium and 1185 mg/l for fluoride. (Author's abstract)
W87-07054

SURVIVAL OF TAPEWORM EGGS, FREE AND IN PROGLOTTIDS, DURING SIMULATED SEWAGE TREATMENT PROCESSES,
Luton Coll. of Higher Education (England).
G. W. Storey.
Water Research WATRAG, Vol. 21, No. 2, p 199-203, February 1987. 7 fig, 21 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Tapeworm eggs, *Survival, *Proglottids, Temperature effects, Sludge, Taenia.

The survival of Taenia saginata eggs in stored sludge, anaerobic and aerobic mesophilic and thermophilic digesters is examined, particularly with reference to the protection afforded to eggs bound within proglottids. Gross survival times paralleled the results of other workers. However, proglottid bound eggs always survived for longer periods than did freshly dissected eggs. The consequences of this for experimentation is discussed. T. saginata eggs were killed in all treatments with anaerobic digestion being more effective than aerobic digestion and lagooning. In all processes the major controlling factor was temperature; at 35 C eggs were killed faster than at 20 C, eggs at 55 C survived for only a few hours whether free or in proglottids. (Author's abstract)
W87-07055

OXYGEN UPTAKE STUDIES ON VARIOUS SLUDGES ADAPTED TO A WASTE CONTAINING CHLORO-, NITRO- AND AMINO-SUBSTITUTED XENOBIOTICS,
Birmingham Univ. (England). Biochemical Engineering Section.
M. K. Dosanjh, and D. A. J. Wase.
Water Research WATRAG, Vol. 21, No. 2, p 205-209, February 1987. 4 fig, 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Toxicity, *Biodegradation, *Fate of pollutants, Xenobiotic compounds, Aromatic compounds, Effluents, Oxygen, Sludge, Metabolism, Acclimatization.

Although containing very low concentrations of organics, triaminotrinitrobenzene (TATB) effluent still appeared toxic in shake-flask experiments. Few toxicity effects showed in model activated-sludge plants, provided that these contained suitably adapted organisms, and were run on phenolic waste or phenol as a basic carboniferous load. Oxygen uptake studies indicated that the metabolic processes within the sludge population appeared unusual, and that degradation of TATB effluent required a sludge which was specially adapted. (Author's abstract)
W87-07056

COMPETITION IN DENITRIFICATION SYSTEMS AFFECTING REDUCTION RATE AND ACCUMULATION OF NITRITE,
Technische Univ. Hamburg-Harburg (Germany, F.R.).
P. A. Wilderer, W. L. Jones, and U. Dau.
Water Research WATRAG, Vol. 21, No. 2, p 239-245, February 1987. 6 fig, 4 tab, 9 ref. German Ministry of Research and Technology Contract 02 WA 225.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Denitrification, *Nitrites, *Model studies, *Nitrates, Microbiological studies, Reduction, Accumulation, Sludge.

During the process of dentrification of wastewater nitrite has often been observed to accumulate, most probably because of the nitrite reduction rate falling behind the rate of nitrate reduction. The hypothesis to be investigated was that microbial communities could be enriched for facultative anaerobes capable of reducing nitrate, but only to nitrite. A mathematical model was developed, and experiments were conducted to study results of enhanced proliferation of facultative anaerobes, on the expense of true denitrifiers, in activated sludge biocommunities. A lab-scale sequencing batch reactor system was employed for the studies. As predicted, the rate of nitrite reduction progressively decreased whereas the nitrate reduction rate remained almost unaffected, when fermentation conditions were introduced into the process schematic. Implications in design and operation of wastewater treatment plants are discussed. (Author's abstract)
W87-07062

INHIBITION OF METHANOGENESIS FROM ACETATE IN GRANULAR SLUDGE BY LONG-CHAIN FATTY ACIDS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
I. W. Koster, and A. Cramer.
Applied and Environmental Microbiology AEMIDF, Vol. 53, No. 2, p 403-409, February 1987. 3 fig, 3 tab, 39 ref. Dutch Government Clean Technology Program Grant (E.41)LH511.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Fatty acids, *Anaerobic digestion, *Toxicity, Methane bacteria, Inhibition, Biomass, Methanogenesis, Synergistic effects.

The effect of four saturated long-chain fatty acids (caprylic, capric, lauric, and myristic) and one unsaturated long-chain fatty acid (oleic) on the microbial formation of methane from acetate was investigated in batch anaerobic toxicity assays. The tests were carried out with granular sludge from an upflow anaerobic sludge bed reactor. In this sludge, Methanothrix spp. are the predominant acetoclastic methanogens. Lauric acid appeared to be the most versatile inhibitor: inhibition started at 1.6 mM, and at 4.3 mM the maximum specific acetoclastic methanogenic activity had been reduced to 50%. Caprylic acid appeared to be only slightly inhibitory. Oleic acid was almost as inhibitory as lauric acid. Although adsorption of the inhibitor on the cell wall might play an important role in the mechanism of inhibition, the inhibition was found to be correlated with concentration rather than with the amount per unit of biomass. In practical situations, as in anaerobic waste treatment processes, synergism can be expected to enhance the inhibition of methanogenesis. In the present research a background concentration of lauric acid below its MIC strongly enhanced the toxicity of capric acid and (to an even greater extent) myristic acid. (Author's abstract)
W87-07080

ALTERNATING AEROBIC AND ANAEROBIC OPERATION OF AN ACTIVATED SLUDGE PLANT,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
S. Gonzalez-Martinez, R. Staud, P. A. Wilderer, L. Hartman, and M. Norouzian.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 65-71, February 1987. 7 fig, 3 tab, 17 ref. German Ministry of Research and Technology Grant 02WA 736/737.

Descriptors: *Activated sludge process, *Activated sludge, *Wastewater treatment, *Aerobic treatment, *Anaerobic digestion, *Organic loading, Sludge, Aerobic conditions, Anaerobic conditions, Waste load, Mathematical equations, Domestic wastes, Industrial wastes, Water treatment facilities, Aeration, Effluents, Sedimentation, Secondary wastewater treatment, Hydraulic loading, Biological wastewater treatment.

A full-scale activated sludge plant treating a mixture of domestic and industrial waste was optimized by smoothing the organic load. This was achieved by matching the number of aeration tanks in service with the receiving organic loading. Aeration tanks not in service were used to store the sludge under anaerobic conditions. The results indicated that this sequential aerobic/anaerobic oper-

ation did not affect the activity of the sludge, the overall efficiency of the plant, the quality of the effluent, or the sedimentation properties of the activated sludge. A shift of the microbial population toward facultative organisms, which did not affect the treatment capacity of the activated sludge, was observed with the aerobic/anaerobic operation. As the organic load increased, the consumption of electric power decreased which was attributed to the reduction of the actual hydraulic detention times by taking unnecessary parts of the reactor volume out of service. (Wood-PTT)
W87-07095

EVALUATION OF A PULSED BED FILTER FOR FILTRATION OF MUNICIPAL PRIMARY EFFLUENT,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
D. S. Brown.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 72-78, February 1987. 2 fig, 8 tab, 15 ref.

Descriptors: *Wastewater treatment, *Filtration, *Pulsed bed filters, *Primary wastewater treatment, *Filters, Performance evaluation, Detergents, Cleaning, Load distribution, Suspended solids, Chemical oxygen demand, Turbidity, Backwash, Effluents, Municipal wastewater.

Five operating procedures of a pulsed bed filter were varied to note the effect on performance: a higher number of pulses (25 versus 5); longer time between pulses (10 minutes versus 2.5 minutes); smaller detergent volume (7% versus 25%); less frequent cleaning (every other day versus everyday); and lower surface loading rate (SLR) (80 versus 160 L/sq m/min) were found to be better. SLR had the most noticeable effect on performance; time between pulses had the next most noticeable effect. Performance ranged widely, but means were: total suspended solids, chemical oxygen demand, and turbidity removals of 62, 26, and 48%, respectively, filter runs of 3.3 hours; ratio of backwash-water-pumped-volume of 26%; and ratio of backwash-water-wasted to influent volume of 6.2%. Because the values range so widely, care must be taken in picking a design value, or pilot studies must be made. Operation of the filter was generally reliable; however, the filter had to be routinely cleaned or failure, caused by excessive biological slime buildup, cementing of the sand bed, or excessive sand loss, was possible. (Author's abstract)
W87-07096

CONVERSION OF SMALL MUNICIPAL WASTEWATER TREATMENT PLANTS TO SEQUENCING BATCH REACTORS,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. Melcer, W. K. Bedford, B. H. Topnik, and N. W. Schmidtke.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 79-85, February 1987. 4 fig, 6 tab, 18 ref.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Municipal wastewater, *Domestic wastes, *Sequencing batch reactors, Manitoba, Canada, Aeration, Performance evaluation, Mine drainage, Mine wastes, Effluents, Water quality standards, Biochemical oxygen demand, Wastewater, Suspended solids, Fouling, Clogging, Pumps, Costs, Capital costs, Operating costs, Design criteria.

The feasibility of converting small wastewater treatment plants to sequencing batch reactor systems was investigated at three locations in Manitoba, Canada. Two were extended aeration plants with a history of erratic and poor performance. The third was converted from septic tanks. Two plants treated domestic wastewater from small communities and received flows of 4 and 230 cu m/day. The other plant treated gray water from a mining camp (flow 23 cu m/ day). The performance of each modified plant was assessed over a three-month period. Despite high variables in influent characteristics, stable high quality effluents were observed at all locations in terms of 5-day biochemical oxygen demand and total suspended solids. Fouling of low level liquid probes and clogging of transfer pumps were identified as the only operation problems. Minimal operator attention was required. Capital and operating costs were established. Tank volume, effluent drawoff location, and periods of aeration and settling were identified as important design considerations. (Author's abstract)
W87-07097

IMPROVING HEAVY METAL SLUDGE DEWATERING CHARACTERISTICS BY RECYLING PREFORMED SLUDGE SOLIDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and R. T. Kelley.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 86-91, February 1987. 9 fig, 1 tab, 22 ref.

Descriptors: *Sludge drying, *Heavy metals, *Recycling, *Sludge thickening, *Dewatering, *Sludge, *Wastewater treatment, Nickel, Solids, Wastes, Mathematical equations.

The ability to modify sludge characteristics through changes in the precipitation stage of heavy metals treatment was considered. A continuous-flow hydroxide precipitation treatment system was operated for soluble nickel removal and sludge generation, Sludge floc size distribution and density were quantified and directly correlated to sludge properties. Results indicated that the recycle of preformed sludge solids increases the density of Ni(OH)2 sludge with corresponding improvements noted in both the rate and extent of dewatering achieved by gravity thickening and mechanical systems. (Author's abstract)
W87-07098

MODELING AN AERATED BUBBLE AMMONIA STRIPPING PROCESS,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
S. E. Powers, A. G. Collins, J. K. Edzwald, and J. M. Dietrich.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 92-100, February 1987. 9 fig, 2 tab, 18 ref.

Descriptors: *Wastewater treatment, *Ammonia, *Model studies, *Mathematical models, *Industrial wastewater, *Ammonia stripping, Ammonium compounds, Ammonium, Wastewater, Semiconductor manufacturing, Chemical wastes, Aeration, Mathematical studies, Mathematical equations, Field tests, Prediction, Vermont, Pretreatment of water, Cost analysis, Economic aspects, Operating costs, Flow rates.

Wastewater from the manufacture of semiconductor chips contains ammonium hydroxide and ammonium fluoride. These chemicals often need to be removed before discharge. The operating parameters that affect the removal rate of ammonia from a high temperature aerated bubble stripper were examined and a theoretical mathematical model describing ammonia stripping was examined. The mathematical model was calibrated from field data, was verified using independent field data, and was then used as a predictive tool to determine optimum stripping conditions for an industrial semiconductor wastewater plant. The wastewater treatment plant at the International Business Machine site located at Essex Junction, Vermont, uses an aerated stripping tank as a pretreatment process to remove high concentrations of ammonia (4000 milligrams/L NH3-N) and fluoride (10,000 milligrams/L F(-)) from their concentrated wastewater. The air stream and water droplets remove ammonia from the wastewater. The fluoride is separated in a thickener as an insoluble calcium fluoride precipitate. The model predicts a 30% operating cost reduction for the ammonia stripping process by increasing the stream and air flow rates and decreasing the operation contact time, compared to current standard operating procedures. (Author's abstract)
W87-07099

COAGULATION OF ORGANIC SUSPENSIONS WITH ALUMINUM SALTS,
Delaware Univ., Newark. Dept. of Civil Engineering.
S. K. Dentel, and J. M. Gossett.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 101-108, February 1987. 14 fig, 2 tab, 33 ref. NSF Grant CME-7923267.

Descriptors: *Wastewater treatment, *Coagulation, *Chemical coagulation, *Aluminum salts, *Organic wastes, *Suspended solids, Suspension, Aluminum, Clarification, Clarifiers, Clarified wastewater, Particle size, Wastewater, Data interpretation, Wastewater facilities, Chemical precipitation, Sludge, Turbidity, Biodegradation, Sludge digestion, Simulation.

Wastewater coagulation was characterized in a series of laboratory experiments. Two different types of organic suspensions were created to simulate the concentration, size, and charge of particles measured in a primary clarifier, and these suspensions were coagulated in controlled jar tests. The four zones typically observed for coagulation in water treatment were also exhibited in these experiments, but the data indicated that some modifications to the conventional explanations of these zones were necessary. Most importantly, the role of aluminum hydroxide precipitation must be considered when describing Zone 2 destabilization. Coagulation with Zone 2 doses also reduced anaerobic biodegradability of the resulting sludges much less than did Zone 4 doses. Implications of these findings are discussed with regard to coagulation strategy for wastewater treatment plants and necessary trade-offs in turbidity removal, coagulant consumption, sludge production, and sludge digestibility. (Author's abstract)
W87-07100

UPTAKE OF METAL IONS BY SULFONATED PULP,
McGill Univ., Montreal (Quebec). Dept. of Chemical Engineering.
A. A.-H. Ali, D. G. Cooper, and R. J. Neufeld.
Journal - Water Pollution Control Federation JWPFA5, Vol. 59, No. 2, p 109-114, February 1987. 12 fig, 1 tab, 24 ref.

Descriptors: *Wastewater treatment, *Sulfonates, *Ions, *Metals, Pulp and paper industry, Hydrogen ion concentration, Cations, Metal complexes, Mathematical equations, Regression analysis, Sorption, Heavy metals.

A highly-sulfonated chemimechanical pulp was investigated for metal uptake capabilities. It was found that the pulp behaved as an ion exchanger in almost all aspects of sorption investigated including metal affinity, uptake rate, pH dependency, effect of complexing ligands and selectivity. This material has a metal uptake capacity of up to 0.19 mmol/g and was effective in the removal of metals at very low concentration ranges. The amount of uptake of the cations was directly related to the ionic radii of UO2(2+), Pb(2+), La(3+), Cd(2+), and Cu(2+). The presence of anions inhibited metal uptake relative to the complexation abilities of the ions, relative molar ratios, and solution pH. Cation competition followed a similar order to that of uptake capacity; the larger cation was preferred by the pulp. (Wood-PTT)
W87-07101

DEVELOPMENT OF A TOTAL SUSPENDED SOLIDS STANDARD,
International Paper Co., Mobile, AL. Erling Riis Research Center.
For primary bibliographic entry see Field 5A.
W87-07102

ACTIVATED SLUDGE-CHLORINE REACTIONS DURING BULKING CONTROL,
California Univ., Los Angeles. Dept. of Civil Engineering.
J. B. Neethling, Y. C. Chung, and D. Jenkins.
Journal of Environmental Engineering JOEDDU

(ASCE), Vol. 113, No. 1, p 134-146, February 1987. 6 fig, 2 tab, 24 ref.

Descriptors: *Bulking sludge, *Wastewater treatment, *Flocculation, *Activated sludge, *Chlorination, *Flocculation, *Kinetics, *Biological wastewater treatment, Mathematical analysis, Suspended solids, Settling.

Chlorine is often added to activated sludge to cure filamentous activated sludge bulking. Filamentous bacteria must be killed while floc forming bacteria survive during chlorination of activated sludge to cure bulking. The hypothesis that the flocforming bacteria are shielded from the chlorine by their protected position inside the activated sludge floc is tested. The rapid reaction of free chlorine and activated sludge floc material can limit the penetration of free chlorine to the surface of the activated sludge floc, thus providing some protection for the bacteria inside the floc. Monochloramine reacts slowly and will penetrate the activated sludge floc completely. (Penetration is rapid: 80% of the floc diameter in 1 sec). Mechanisms other than protection due to position deep inside the floc may account for floc former resistance to monochloramine. (Airone-PTT)
W87-07126

EFFECT OF SLOWLY BIODEGRADABLE ORGANICS ON KINETIC COEFFICIENTS,
Maryland Univ., College Park. Dept. of Civil Engineering.
O. J. Hao, and C. T. Li.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 147-154, February 1987. 5 fig, 1 tab, 10 ref.

Descriptors: *Biological oxygen demand, *Wastewater treatment, *Chemical oxygen demand, *Biological wastewater treatment, *Kinetics, *Activated sludge process, Metabolites, Design criteria.

Measurement of both soluble COD and BOD on activated sludge effluent reveals that effluent organic matter contains a significant quantity of slowly biodegradable organics. These substances exhibit a significant effect on the determination of kinetic coefficients, e.g., the substrate removal rate for the multiple substrate model and the first-order rate constant. The use of effluent soluble COD for estimating the yield coefficient and decay rate, however, is valid under many practical conditions, since concentration of the influent substrate is much greater than that of the effluent. Data were obtained from a laboratory completely mixed activated sludge system with cell recycle, using starch waste from a corn starch process plant. (Airone-PTT)
W87-07127

WEIR-ORIFICE UNITS FOR UNIFORM FLOW DISTRIBUTION,
Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W87-07128

LABORATORY SIMULATION OF MUNICIPAL SOLID WASTE FERMENTATION WITH LEACHATE RECYCLE,
Barcelona Univ. (Spain). Dept. de Quimica Tecnica.
J. Mata-Alvarez, and A. Martinez-Viturtia.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 36, No. 12, p 547-556, December 1986. 5 fig, 5 tab, 15 ref.

Descriptors: *Leachates, *Wastewater treatment, *Model studies, *Recycling, *Municipal wastes, Simulation, Methane, Kinetics, Biological treatment, Anaerobic digestion, Biodegradation, Fermentation.

The possibilities of methane extraction from a large landfill situated in Garraf, near Barcelona, are examined. Municipal solid waste fermentation was simulated for landfill conditions using five test cells operated at different temperatures. The digestion was carried out under enhanced conditions (leachate recycle with supplemental water spiked with added buffer and inoculum). Leachate recycle was set up in all test cells. Depending on temperature, the digestion was complete (>90% biodegradable matter converted) in a period of 25 to 57 days. Optimum operating temperatures were in the range of 34 to 38 C. Two kinetic models were fitted to the experimental data. Their kinetic constants were related to temperature using an Arrhenius expression. Landfill life operated under the studied conditions could be reduced to less than 2 years. (Airone-PTT)
W87-07141

SOME OBSERVATIONS ON THE MORPHOLOGY AND THE ANATOMY OF FILAMENT TYPE 0041,
Potchefstroom Univ. for C.H.E. (South Africa). Dept. of Microbiology.
P. A. J. Brand, L. R. Tiedt, and V. L. Hamilton-Atwell.
Water S. A. WASADV, Vol. 13, No. 1, p 1-6, January 1987. 8 fig, 16 ref.

Descriptors: *Activated sludge process, *Filamentous bacteria, *Wastewater treatment, *Biological wastewater treatment, Flocculation, Bulking sludge, Morphology, Electron Microscopy.

Some morphological and anatomical characteristics as determined by light, transmission electron and scanning electron microscopy are reported for filament type 0041. The filament is procaryotic, but the dimensions differ slightly from those quoted in literature. The relation between the sheath and the bacterial filament is clearly indicated. The sheath is not tight-fitting as described in literature. As far as could be determined it was the first time that this observation was made. Furthermore the sheath appears to be transparent. The observation on the specimens fixed in Karnovski is important because samples can be preserved for several weeks without the loss of their Gram and Neisser characters. (Author's abstract)
W87-07148

MATERIAL BALANCE OF THE COMPOSTING PROCESS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. Obrist.
Biocycle BCYCDK, Vol. 28, No. 2, p 32-33, February 1987. 4 tab.

Descriptors: *Composting, *Domestic wastes, *Aerobic digestion, *Organic wastes, Standards, Switzerland, Recycling, Heavy metals, Zinc, Lead, Organic compounds.

Material balances for important elements and volatile matter were examined in two test series at the Swiss Federal Institute for Water Resources and Water Pollution Control. The greatest quantitative variation in the material undergoing composting occurred in the amount of organic substances (about 40% loss). Due to their restricted mobility, heavy metals show a relative accumulation (theoretically about 2/3 of their initial value) in the composting material. Tables characterize the composition of the initial and final compost, and describe the leachate concentrations of nitrogen, phosphorus and metals which resulted from the experiment. (Airone-PTT)
W87-07166

SMALL COMMUNITIES HELP THEMSELVES,
For primary bibliographic entry see Field 6B.
W87-07168

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART II-BIOLOGICAL PROCESS CONTROL,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5G.
W87-07169

WASTEWATER PROBLEMS SOLVED BY NATURAL COMBINATION,
Lombardo and Associates, Inc., Boston, MA.
P. Lombardo, and T. Neel.
Biocycle BCYCDK, Vol. 28, No. 2, p 48-50, February 1987.

Descriptors: *Local governments, *Public opinion, *Sewer systems, *Wetlands, *Wastewater treatment, Sand filters, Financing, Maryland, Septic tanks, Environmental protection, Community development.

Construction has started on an innovative $46 million wastewater management plan for the Mayo Peninsula in Maryland which uses a combination of 'natural' processes and simple on-site treatment. The plan ends more than 20 years of public debate and resistance to previous wastewater management plans. The current plan does not subsidize growth nor promote sewering undeveloped areas, but it provides for orderly growth. The plan integrates three treatment approaches: on-site septic systems, cluster soil absorption systems, and a communal treatment system. For the first time in the U.S., a major public utility will manage, finance, and operate individual septic systems as part of an overall wastewater management system. Clusters of homes will be served by leaching fields in two areas which will purify septic tank effluent. The final component is a five-step communal treatment system that will treat effluent from a septic tank/effluent collection system and will consist of recirculating sand filters, UV disinfection, and three different kinds of man-made wetlands. Each of these aspects, and the financing of the project as well, are discussed. The plan demonstrates that use of man-made wetland systems in combination with simple alternative techniques for wastewater treatment is a technically sound and cost-effective solution in a non-rural setting. (Airone-PTT)
W87-07170

ECONOMIC FEASABILITY OF ANAEROBIC DIGESTERS,
G. K. Criner.
Biocycle BCYCDK, Vol. 28, No. 2, p 51-53, February 1987. 1 tab, 2 ref.

Descriptors: *Electric power production, *Anaerobic digestion, *Cost repayment, *Economic feasability, Energy, Farm wastes, Market value, Oil, Electric power rates.

The on-farm anaerobic digester as an alternative energy system can be rendered more or less economically viable by fluctuations in the prices of oil and electricity. The author's analysis shows that a digester of a particular size (200 cow equivalents) is economically feasible under the conditions: electricity 9 cents per kwh, oil 40 cents per gallon. The payback term for such conditions is 17 years. A table gives net present values and payback terms for other sets of conditions. It turns out that the price of electricity is more crucial to feasibility of this system than is the price of oil. The economic viability of the system also depends on local regulations regarding rates to be paid to small producers of electric power. (Airone-PTT)
W87-07171

IMPACT OF CALCIUM MAGNESIUM ACETATE ROAD DEICER ON POTW OPERATION,
For primary bibliographic entry see Field 4C.
W87-07203

MANAGEMENT OF TOXIC AND HAZARDOUS WASTES.
For primary bibliographic entry see Field 5E.
W87-07243

LIQUID HAZARDOUS WASTE TREATMENT DESIGN,
Dravo Recovery Systems.
T. H. Coughlin, O. A. Clemens, and J. Johnson.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 141-153, 4 fig, 7 tab.

Descriptors: *Wastewater treatment, *Design criteria, *Hazardous wastes, Regulations, Industrial wastewater, Landfills, Pretreatment.

The onset of stringent environmental regulations dealing with the disposal of liquid hazardous waste has prompted B.K.K. Corporation to begin the design and development of a liquid hazardous waste treatment facility. A waste characterization and laboratory treatment program determined that the majority of liquid hazardous waste could be composited into two treatable streams. The design of a treatment facility was then based on previous experience gained from other operating facilities, and further verified by the installation of a pilot plant utilizing actual plant size equipment. The net results of the treatment process is that 75% of the total treatable waste will not be landfilled, but discharged into a sanitary sewer system after meeting stringent pretreatment standards. The cake product will be landfilled in an environmentally much safer form than the original hazardous liquid. The landfills active life will be extended and the potential problem of liquid leachate caused by hazardous liquid implacement restricted. (See also W87-07243) (Lantz-PTT)
W87-07256

IN SITU STABILIZATION AND CLOSURE OF AN OILY SLUDGE LAGOON,
Weston (Roy F.), Inc., West Chester, PA.
J. W. Thorsen, F. Coia, and A. A. Metry.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 155-169, 5 fig, 3 tab.

Descriptors: *Oil pollution, *Waste disposal, *Sludge lagoons, *Stabilization lagoons, Asphalts, Industrial wastes, Wastewater treatment, Disposal sites, In situ tests, Cost analysis.

An inactive lagoon site occupies over four acres in western Pennsylvania. The focal point of the site is the open lagoon, an earthen diked lagoon of about one acre, containing approximately 30,000 cu yd of asphaltic sludge and 200,000 gallons of acidic liquid supernatant. Operation of the site began in the 1930's when the oil company used the lagoon for the disposal of white oil production wastes. For a period of over 40 years, the lagoon was used for the disposal of sludge residues. The waste material consists of white oil production wastes, residue from waste motor oil re-refining, coal fines, and fly ash. In 1968, when a spill of an estimated 3,000 gallons occurred, the Allegheny River was drastically impacted, killing an estimated 4,000,000 fish and resulting in the shutdown of water supplies. The following conclusions could be drawn from this case history: (1) oily waste lagoons containing asphaltic-type waste may tend to be self-sealing; (2) removal and off-site disposal of such waste is often one order of magnitude more costly than in situ or on-site management and containment; (3) utilization of common pozzolana (cement kiln dust, fly ash and lime, cement, soil and lime, etc.) is effective in improving the physical and structural properties of the oily waste in preparation for lagoon closure; (4) in-situ solidification and closure of inactive oily waste lagoons is technically feasible and cost effective; (5) mixing of pozzolana and sludge could be achieved by using either mechanical mixing (e.g., a pub mill or earth-moving equipment (e.g., a backhoe); (6) containment of solidified waste could be achieved by using perimeter dikes and multilayer cover system consisting of a cap, a drain layer, and a soil cover to support vegetation; and (7) this in-place closure concept is a passive remedial action approach that requires only minimal postclosure monitoring and maintenance. (See also W87-07243) (Lantz-PTT)
W87-07257

HAZARDOUS WASTE REDUCTION THROUGH IN-PROCESS CONTROLS, PROCESS SUBSTITUTIONS, AND RECOVERY/RECYCLING TECHNIQUES,
Battelle Columbus Labs., OH.
J. A. Gurklis.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 171-194, 4 fig, 4 tab, 13 ref.

Descriptors: *Hazardous wastes, *Metal-finishing wastes, *Wastewater treatment, *Process control, *Recycling, Effluents, Sludges, Evaporation, Reverse osmosis.

Compliance with effluent guidelines (for waters discharged to streams), pretreatment standards (for waters discharged to publicly owned treatment works (POTW)), and with RCRA (Resource Conservation and Recovery Act) regulations has resulted or will result in significant cost increases for firms carrying out electroplating and metal finishing operations. Currently, recovery of metal values from mixed wastewater treatment sludges is generally not practical for technical or economic reasons. The recovery problems relate to the fact that metals in mixed metal sludges are generally difficult to separate and may involve relatively complex and costly chemical and/or metallurgical procedures. Accordingly, in-process recovery and/or recycling of plating and other processing bath chemicals contained in rinsewaters appear to be promising approaches to reduce processing chemicals costs as well as to minimize the quantity of metal-bearing sludges generated. Amongst the more promising and more widely used techniques employed in electroplating and metal finishing plants for economical recovery/recycling of valuable plating chemicals now going to waste treatment are evaporation, reverse osmosis, and 'save rinses'. A discussion of these technologies together with detailed costing of representative recovery/recycling operations by the use of evaporation and reverse osmosis are presented. (See also W87-07243) (Lantz-PTT)
W87-07258

WATERWAY CONTAMINATION - AN ASSESSMENT OF CLEANUP PRIORITIES,
Malcolm Pirnie, Inc.
For primary bibliographic entry see Field 5G.
W87-07267

PROPOSED WASTEWATER TREATMENT FACILITIES, GREENE COUNTY, MISSOURI.
Environmental Protection Agency, Kansas City, MO. Region VII.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84-242593, Price codes: A11 in paper copy, A01 in microfiche. Final Environmental Impact Statement. EPA Report No. EPA 907/9-84-003, June 1984. 220 p, 5 fig, 13 tab.

Descriptors: *Environmental effects, *Wastewater treatment facilities, *Greene County, *Missouri, *Wastewater pollution, Economic aspects, Riparian habitat, Landfills, Erosion, Cost analysis.

This final environmental impact statement addresses the social, economic, and natural environmental impacts potentially resulting from implementation of the proposed comprehensive wastewater treatment facilities presented in the Wastewater Facilities Plan for Greene County, prepared concurrently with this document. The Greene County planning area for these studies was divided into subareas, including the City of Springfield, six outlying communities, and the remaining unincorporated area. Impacts of the recommended alternatives were generally found to be beneficial, particularly to surface and groundwater quality and efficient land use planning. Mitigative measures are required to reduce adverse environmental impacts, including damage to riparian habitat and archaeological resources, potential problems in sinkhole, losing stream, and landfill areas, stream sedimentation, and erosion. Cost impacts to residents in presently unsewered areas will be great, despite efforts to reduce them. Cost impacts for residents of the sewered areas of Springfield will be moderate. Four of the outlying communities propose to deliver wastewater to the City of Springfield for treatment. This regionalization was found to be environmentally and economically sound. (Author's abstract)
W87-07336

POLLUTANT REMOVAL CAPABILITY OF URBAN BEST MANAGEMENT PRACTICES IN THE WASHINGTON METROPOLITAN AREA.
Metropolitan Washington Council of Governments, DC. Water Resources Planning Board.
For primary bibliographic entry see Field 5G.
W87-07365

DEMONSTRATION OF THERMOPHILIC AEROBIC-ANAEROBIC DIGESTION AT HAGERSTOWN, MARYLAND,
Union Carbide Corp., Tonawanda, NY. Linde Div.
O. W. Haas.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-238252. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA-600/2-84-142, August 1984. 108 p, 35 fig, 12 tab, 14 ref, 6 append. EPA Grant S-805823-01-0.

Descriptors: *Wastewater treatment, *Thermophilic bacteria, *Hagerstown, *Maryland, *Anaerobic digestion, *Aerobic digestion, Digestion, Digested sludge, Sludge digestion, Pathogens, Performance evaluation.

A thermophilic aerobic-anaerobic digestion system was designed and constructed at the Hagerstown, Maryland Wastewater Treatment Plant. This project establishes the process performance of this dual digestion system in a full-scale design. The system included a short retention-time (approximately 1-day) aerobic digester followed by a high rate anaerobic digester. Approximately 16,400 gal/day of thickened, air-activated sludge was autothermally heated by aerobic oxidation of organic substrates in the first step and then anaerobically digested in the second step, with the formation of methane gas. Data were collected to evaluate the system's performance regarding volatile solids destruction, oxygen consumption, power draw, heat production, pathogen reduction and process stability. Thermophilic temperatures (greater than 46 C) were rapidly achieved upon start-up of the dual digestion system and were maintained in the aerobic reactor at a hydraulic retention time of approximately 1 day. The high shear aeration device demonstrated sufficient oxygen transfer capacity to achieve and maintain these high temperatures at power densities of 0.5 to 1.1 shaft horsepower/1000 gal, and high purity oxygen feed flows of 10-33 CFM-NTP in the aerobic reactor. The system responded well to variations in feed flow and solids concentration as well as operational upsets. Analyses were performed that illustrate the capability of the dual digestion system for achieving significant reductions in the level of pathogenic organisms in sewage sludge. Finally, over the course of some 20 weeks of operation, the dual digestion system proved itself an effective sludge stabilization process, achieving an overall volatile solids reduction of 41.6%. (Author's abstract)
W87-07368

SEWAGE SLUDGE INCINERATOR FUEL REDUCTION, HARTFORD, CONNECTICUT,
Indianapolis Center for Advanced Research, IN.
A. J. Verdouw, E. W. Waltz, and P. F. Gilbert.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-243096. Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-84-146, August 1984. 45 p, 15 fig, 13 tab, 6 ref. Pa Contract 68-02-3169.

Descriptors: *Wastewater treatment, *Sludge drying, *Incineration, *Hartford, *Connecticut, Water pollution control, Performance evaluation, Economic aspects, Dewatering, Cost analysis.

A field demonstration project was conducted to reduce fuel consumption in municipal sludge incinerators by using a more fuel-efficient operating mode. The Hartford Metropolitan District Commission demonstrated the new operating mode at its Hartford Water Pollution Control Plant using three conventional multiple-hearth sludge incinerators. The fuel-efficient incinerator operating mode was developed from an extensive program of combustion engineering measurement, testing, and operational analysis. Incinerator operators were then given on-the-job training in the new operating

mode during a 14 day demonstration test period. After 12 months of routine operations with the new operating mode, a fuel reduction of 51% was achieved, representing fuel cost savings of approximately $250,000/yr. The Hartford Water Pollution Control Plant had just completed a conversion of its sludge dewatering equipment from vacuum filters to continuous-belt filter presses when this project was initiated. The conversion to belt filter presses had already resulted in major fuel savings, reducing the average specific fuel consumption by more than 65%. The fuel reduction achieved from using the new operating mode was in addition to these savings from dewatering. Together, the annual fuel cost savings from dewatering and improved incinerator operation amounted to $1.3 million. The Hartford experience demonstrates very clearly the relative contributions that both dewatering improvements and incinerator operating mode can have on reducing fuel consumption in multiple-hearth incinerators. This experience also shows that even when the dewatering process has been substantially improved, further efforts to improve the incinerator operating mode are very cost effective. Comparison of fuel reduction achieved in four major cities through use of new incinerator operating modes are also reported. (Author's abstract)
W87-07369

SAFETY AND HEALTH IN WASTEWATER SYSTEMS: MANUAL OF PRACTICE 1.
Water Pollution Control Federation, Alexandria, VA.
Water Pollution Control Federation, Washington, DC. 1983. 116 p, 13 fig, 18 tab.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Safety, *Training, Personnel, Operating policies.

This manual covers three areas of concern: safety responsibilities, programs, and personal protective equipment; safe work procedures; and system control. The manual is intended to be used by operators, managers, and others responsible for employee safety and health. Another Federation publication, 'Guidelines for Developing a Wastewater Safety Program', is suggested as a companion manual because of its focus on management's role in promoting safe work procedures and developing safety programs. This manual of practice suggests specific procedures to be used in a given task. It includes sources of additional material. The manual describes industry practices, along with new or recent safety procedures applicable to the wastewater industry. (Lantz-PTT)
W87-07370

SLUDGE MANAGEMENT AND DISPOSAL FOR THE PRACTICING ENGINEER,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, G. C. Hartman, and E. T. Skene.
Lewis Publishers, Inc. Chelsea, Michigan. 1986. 341 p.

Descriptors: *Wastewater treatment, *Wastewater management, *Sludge, *St. Petersburg, *Florida, Regulations, *Sludge disposal, Case studies, Economic aspects.

The wastewater treatment profession is unique in that it has little control over the raw material it has to process. With some minor exceptions, such as industrial pretreatment requirements and sewer surcharges, the wastewater treatment plant operator literally must accept whatever comes down the pipe, and treat it so as to produce a clean water which can be discharged into the environment. This book is divided into two parts. Part I is a review of the considerations that engineers must understand when starting a sludge management study. Included in this part is a section on regulatory considerations. Since this book is intended mainly for engineers working in the United States, only federal and individual state regulations are addressed. The second part of the book is a case study conducted for the City of St. Petersburg, Florida. Because St. Petersburg presents many of the problems associated with sludge disposal, it is an excellent example of how the principles outlined Part I of this book are applied in practice. This case study also includes information on available technologies and costs of alternatives, and this information can be of great assitance to other engineers embarking on similar studies for their clients. (Lantz-PTT)
W87-07387

TRACE ORGANICS REMOVAL BY GRANULAR ACTIVATED CARBON,
Los Angeles County Sanitation Districts, Whittier, CA.
R. Nur, and R. W. Horvath.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 184 255/AS, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Report No. RU-84/5, March 1985. 114 p, 12 fig, 19 tab, 16 ref, append. DOI Contract No. 14-34-0001-8812.

Descriptors: *Wastewater treatment, *Activated carbon, *Organic compounds, *Trace levels, Secondary wastewater treatment, Chloroform, Trihalomethanes, Chlorination.

The capability of granular carbon to remove trace organics and potential mutagens from secondary wastewater was assessed. Approximately 10,500 pounds of granular activated carbon was placed in three 1.82 m diameter at the Pomona Advanced Wastewater Treatment Research Facility. An all electrical Shirco carbon regeneration furnace was used to reactivate the spent carbon and was operated at 102 kg/day to 195 kg/day. Four adsorption and three regeneration cycles were used. If the presence of chloroform in carbon-treated water represents the general trace organics breakthrough, then the following observations can be made in comparison of 10, 20, and 30 minutes of carbon adsorption: (1) regardless of the concentration of chloroform entering the carbon columns, none was broken through or detected leaving the final column until the eighth week of operation; (2) the second carbon column (20 minutes contact time) was effective in removal of chloroform for up to three weeks of continuous operation; (3) the first carbon column (10 minutes contact time) seems to be ineffective in complete removal of chloroform; and (4) after eleven weeks of continuous operation during the final adsorption cycle, the chloroform concentration of the effluent of all three carbon columns exceeded that of the secondary effluent entering the first column. The concentrations of the trihalomethanes which were completely removed below the detection limit by the third carbon column showed remarkable increase after chlorination. The removal of trihalomethanes by the three state carbon adsorption system and their formation again after the chlorination process would suggest that the precursors are capable of breaking through even after thirty minutes of carbon treatment. Average removal of mutagens by the first carbon contact column was estimated to be approximately 54% for the six samples assayed on TA98, while the average removal of mutagens by the third column was approximately 74%. The lack of a large amount of trace organic compounds in the Pomona Water Reclamation Plant influent coupled with insufficient and infrequent sampling for purgeable and nonpurgeable target organics analyses were two major shortcomings in determination of unit process removals in this study. (Lantz-PTT)
W87-07392

TREATMENT OF DOMESTIC WASTEWATER FOR REUSE WITH INORGANIC OXIDE ADSORBENTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
B. Batchelor, P. J. Burkett, R. Dennis, J. Lindner, and P.-D. Yang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 184 248/AS. Price codes: A08 in paper copy, A01 in microfiche. Bureau of Reclamation, Washington, D.C. Technical Completion Report RU-83/7, August 1983. 146 p, 33 fig, 8 tab, 203 ref, 3 append. OWRT Grant 14-34-0001-0499, Project OWR-RU-83-7.

Descriptors: *Domestic wastewater, *Wastewater treatment, *Domestic water, *Inorganic compounds, *Water reuse, Organic carbon, Alumina, Magnesia, Silica, Lead, Chromium, Activated carbon, Hydrogen ion concentration, Model studies.

The purpose of this project was to develop data that could be used to evaluate the feasibility of using inorganic oxides to treat domestic wastewater for reuse. This was done by conducting batch equilibrium experiments and jar tests using selected inorganic oxides (alumina, magnesia, silica). Removals of gross organic matter (TOC), specific toxic organics (chloroform, 1,2-dichlorobenzene, endrin), specific toxic inorganics (lead, chromium) and phosphate were measured. A biologically treated domestic wastewater that had been lime coagulated and freeze-concentrated was used. Alumina and granular activated carbon (GAC) were found to remove TOC, chromium, and lead. Alumina was superior to GAC only in removal of lead, and was unable to remove the specific toxic organics. A surface complex adsorption model was developed, and adequately described adsorption of chromium and phosphate on alumina. Silica and magnesia were ineffective in removing TOC, specific toxic organics and chromium under the conditions studied. Both were able to enhance removal of lead at high pH. Results of this project indicate that it is unlikely that inorganic oxides will be widely adopted in advanced wastewater treatment systems. However, they may be useful when additional removal of specific inorganic compounds is necessary. (Author's abstract)
W87-07393

EVALUATION OF OXIDATION/BIOLOGICAL ACTIVATED CARBON TREATMENT FOR INDUSTRIAL WATER REUSE,
Jacobs Engineering Group, Inc., Pasadena, CA.
M. Schwartz.
Available from National Technical Institute Service, Springfield, VA 22161, as PB87 183 257/AS. Price codes: A05 in paper copy, A01 in microfiche. Bureau of Reclamation, Washington, D.C., Technical Completion Report RU-84/7, September 1984. 65 p, 25 fig, 19 tab, 25 ref. OWRT Grant 14-34-0001-0519.

Descriptors: *Wastewater treatment, *Industrial water, *Water reuse, *Activated carbon, Biological treatment, Industrial wastewater, Organic carbon, Ozonation, Biodegradation, Simulation analysis, Pentachlorophenol, Performance evaluation.

The Biological Activated Carbon (BAC) technology was tested for the production of reusable water, low in organics concentration, from industrial wastewater. The test program applied included quality screening, batch scale and continuous flow studies. The quality screening tests for waste characteristics, biostability, oxidation potential and adsorptivity showed that waste streams from a chlorophenol plant, a coal tar production plant, and an oil refinery were good candidates for the BAC technology. Batch scale and continuous flow studies were carried out on the oil refinery and chlorophenol waste streams. The batch scale experimental plan, designed to simulate the individual processes comprising the BAC technology, included ozonation, aerobic biodegradation, and activated carbon adsorption isotherms and kinetics. The test results showed that ozonation of the study waste streams produced favorable preconditioning effects at dosages of 0.1:1 O3 to TOC (total organic carbon) ratio and lower. Adsorptivity was not adversely affected and biodegradation was enhanced, resulting in improved adsorptivity of the biodegraded effluent. The experimental protocol for the granular activated carbon short column tests was designed to simulate, at a shallow depth and a low flow rate, the performance of a continuous flow BAC bed. The results of these tests clearly illustrated a superior performance of the BAC system vis-a-vis the individual performance of adsorption and biodegradation. The BAC technology was determined to be especially viable for the treatment of pentachlorophenol effects to produce reusable water. (Author's abstract)

W87-07394

HIGH AREA UTILIZATION STACK, PART I: DESIGN AND DEVELOP STACK COMPONENTS, BUILD AND TEST A SHORT STACK.
Ionics, Inc., Watertown, MA.
Geological Survey, Reston, Virginia. Final Report, April 1985. 122 p, 88 fig. DOI Contract 14-34-0001-8517.

Descriptors: *Desalination apparatus, *Membrane process, *Design standards, *Electrodialysis, Polyethylene, Brines.

The capability of scaling up membrane desalination modules is an important design characteristic when multi-million gallons per day desalting plants are being considered. An increase in unit module capacity can have a pronounced effect on lowering capital costs. As a result, one of the primary objectives of this project was to extend module scale-up to the maximum extent practicable to effect these potential savings in capital cost. A 54 x 40 inch slanted strap pattern (SSP) spacer was designed from analyses of hydraulic resistance, open area, and membrane support characteristics. The design was scaled back to 9 x 10 inch and 18 x 40 spacer sizes to evaluate the pattern design and potential fabrication methods. Experimental tests on electrodialysis (ED) stacks were begun with the 9 x 10 inch Ionics Stackpack, and design improvements were incorporated into progressively larger stack assemblies to determine flow patterns, hydraulic, desalting, and electrical performance. Test results through the 18 x 40 inch stack size demonstrated a definite flow regime where hydraulic, electrical, and desalting performances compared favorably to the standard Ionics Mark III-4 stack. The project concluded with the fabrication and preliminary testing of a short 54 x 40 inch SSP stack with 20 cell pairs. Each cell pair consisted of: (1) 30 mil thick low density polyethylene (LDPE) dilute spacers and 40 mil LDPE brine spacers fabricated on a conventional Sheridan vertical press; and (2) 22 mil thick AR-204-SXZL-386 anion and CR61-AZL-386 cation transfer membranes. A novel closing assembly consisting of twelve 1 inch diameter screw pipe turnbuckles (solid screws into threaded pipe) sealed the short stack. (Author's abstract)
W87-07395

FEASIBILITY OF TREATING MUNICIPAL WASTEWATER BY LIME CLARIFICATION AND PRESSURE OZONATION (PHASE ONE AND PHASE TWO),
A. G. Hill.
Available from the National Technical Institute Service, Springfield, Virginia 22161, as PB87-187373/AS. price codes: A06 in paper copy, A01 in microfiche. Final Report, March 31, 1983. 111 p, 4 tab, 18 ref, 3 append.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Lime, *Clarification, *Ozonation, Tertiary treatment, Effluents, Gypsum, Carbon adsorption, Economic aspects.

The synergystic combination of lime settling-pressure ozonation as a tertiary treatment of domestic sewage effluent has been technically proven. The combination was found to remove approximately two-thirds of the COD of the secondary effluent. Best results were achieved with a 1:1 molar ratio of lime to gypsum rather than lime alone. The economics of the process are not favorable at this time, but these are subject to radical change with process improvement. As is, the process would be an attractive alternative to carbon adsorption without the necessity of a chlorination disinfection step which would produce halomethanes and other possible carcinogens. Water from this process could be recycled to perhaps one-third of the input fresh water to a municipal system. Additional work is necessary to prove this on a typical hard water effluent and with better control methods which could significantly reduce costs. (Author's abstract)
W87-07423

SORBATE CHARACTERISTICS OF FLY ASH, APPENDIX, FINAL REPORT, VOLUME II,
New Jersey Inst. of Tech., Newark.
J. W. Liskowitz, J. Grow, M. Sheih, R. Trattner, and J. Kohut.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE84-007949. Price codes: A08 in paper copy, A01 in microfiche. August 1983. DOE Report No. DOE/PC/30231-T5(Vol. 2). 344 p, 414 fig. DOE Grant DE-FG22-80PC30231.

Descriptors: *Wastewater treatment, *Sorbates, *Fly ash, *Heavy metals, powerplants, Industrial wastewater, Leaching, Boron, Tin, Manganese, Lead, Copper, Nickel, Zinc, Chromium, Cadmium, Molybdenum, Iron.

These appendices accompany the 'Final Report' of the same title, and contain graphical data pertaining to various wastewater treatments of fly ash from an electric powerplant facility. Cadmium, boron, tin, nickel, lead, molybdenum, copper, chromium, zinc, manganese, and iron leaching and treatments are represented with respect to: (1) militant fly ash; (2) deep hollow fly ash; (3) blend fly ash; (4) Wellmore cactus fly ash; (5) Nora fly ash; (6) Upshur fly ash; and (7) badger fly ash. (Lantz-PTT)
W87-07427

ANAEROBIC DIGESTION OF SCREENED SWINE WASTE LIQUIDS IN SUSPENDED PARTICLE-ATTACHED GROWTH REACTORS,
Auburn Univ., AL. Dept. of Agricultural Engineering.
J. P. Bolte, D. T. Hill, and T. H. Wood.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 543-549, March-April 1986. 5 fig, 8 tab, 14 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Swine wastes, *Biological wastewater treatment, *Bacteria, Pollution load, Performance evaluation, Biomass, Animal wastes.

A study was conducted to determine performance characteristics of anaerobic suspended particle-attached growth (SPAG) reactors treating liquid swine waste. This innovative reactor technology combines characteristics of attached-growth and conventional completely-mixed reactors by 'fixing' active bacterial mass on light weight, highly porous support particles which are suspended in the reactor liquor by fluid mixing. Two reactor temperatures were used, mesophilic (35 C) and thermophilic (55 C), with two replicates at each temperature. Hydraulic retention time (HRT) varied from 10 to 2 days for the mesophilic reactors, and 5 to 1 days for the thermophilic reactors, with volatile solids (VS) loading rates ranging between 0.98 to 11.34 g/L-day, based on an empty-tank volume. The SPAG reactors performed well at all HRT's examined, with some signs of stress occurring at the shortest HRT's for both mesophilic and thermophilic reactors (2 and 1 day, respectively). Volumetric methane productivities ranged from 0.42 to 2.43 L/L-day, and VS reduction ranged from 36.0 to 66.9%. As expected, the thermophilic reactors consistently out-performed the mesophilic reactors at equal VS loading rates. Analysis of the bacteria support particles at the end of the study indicate bacterial concentrations between 14 and 27 g/L particle can be obtained using anaerobic SPAG reactor technology. Of the two support materials examined, a reticulated nylon cuboid appeared to be capable of retaining higher concentrations of bacterial mass than a polyurethane foam, but both material performed adequately. (Author's abstract)
W87-07463

DESIGN OF RAPID FIXED-BED ADSORPTION TESTS FOR NONCONSTANT DIFFUSIVITIES,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, J. K. Berrigan, D. W. Hand, and B. Lykins.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 243-259, April 1987. 5 fig, 5 tab, 21 ref.

Descriptors: *Wastewater treatment, *Adsorption, *Model studies, Pilot plants, Effluents, Dispersion, Isotherms, Kinetics, Equations, Diffusivity.

A rapid small-scale column test (RSSCT) that uses a smaller adsorbent particle is used to simulate a five-month pilot plant adsorption study in several days. The RSSCT is a small-scale physical model of a full-scale fixed-bed such that it gives a performance identical to the full-scale plant when the effluent profiles are plotted as the bed volumes are fed. A mathematical model that includes axial dispersion, intraparticle pore and surface diffusion, and liquid-phase mass transfer resistance is used to scale down the RSSCT from the pilot plant operation without extensive isotherm and kinetic data. This study presents evidence that the surface diffusivities are not necessarily constant with adsorbent particle radius and presents general scaling equations for use under these conditions. (Author's abstract)
W87-07492

ADSORPTION BEHAVIOR OF CU(II) ONTO SLUDGE PARTICULATE SURFACES,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
C.-T. Tien, and C. P. Huang.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 285-299, April 1987. 10 fig, 4 tab, 26 ref. EPA Fellowship EPA U-911732 and NSF Grants CEE8104728 and CEE83-13290.

Descriptors: *Wastewater treatment, *Copper, *Adsorption, *Sludge, Cultures, Nutrients, Proteins, Polysaccharides, Biomass, Chelation, Isotherms.

The influence of culture condition of the production of extracellular polysaccharide, protein, and its effect on the removal of Cu(II) by activated sludge solids is investigated. The surface of sludge particulates grown in low C/N ratio are found to be high in protein but low in polysaccharide content. Both polysaccharide and protein are important to Cu(II) adsorption. The optimal pH values for Cu(II) adsorption are between 5.5 and 6.0. The decrease in Cu(II) adsorption density at pH>7 is attributed to the deterioration of biomass. Soluble COD as high as 190.4 mg/L was detected at pH 9.4. The organic ligands will chelate the Cu(II) ions to form soluble organic complexes that are not adsorbable. Surface loading plays an important role in Cu(II) adsorption. The adsorption of Cu(II) onto the sludge particle surface can be described by a modified Langmuir adsorption isotherm that incorporates the effect of proton. It is found that (H(+)) behaves as a competitive inhibitor. (Author's abstract)
W87-07495

INFLUENCE OF FLOW VELOCITY ON SULFIDE PRODUCTION WITHIN FILLED SEWERS,
Monash Univ., Clayton (Australia). Dept. of Chemical Engineering.
G. A. Holder, and J. Hauser.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 300-310, April 1987. 4 fig, 2 tab, 7 ref, 2 append.

Descriptors: *Sulfides, *Wastewater treatment, *Sewers, *Domestic wastewater, *Flow velocity, Equations, Prediction.

A number of equations developed to predict sulfide formation in filled sewers are compared, and previous work on the effect of flow velocity on sulfide formation is briefly reviewed. An analysis of data recorded in the literature for detailed studies of a filled sewer carrying domestic sewage showed that the sulfide production rate could be correlated with sewage flow velocity. Statements in the literature indicate that the rate of sulfide production is not directly affected by wastewater velocity. Explanations as to why this misleading impression has arisen are proposed. The need for further data on relatively simple systems (such as filled sewers) is apparent. (Author's abstract)

W87-07496

REMOVAL OF CADMIUM FROM WATER BY WATER HYACINTH,
Roorkee Univ. (India). Dept. of Civil Engineering.
O. Prakash, I. Mehrotra, and P. Kumar.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 352-365, April 1987. 16 fig, 3 tab, 8 ref.

Descriptors: *Model studies, *Water treatment, *Water hyacinth, *Cadmium, *Wastewater treatment, Heavy metals, Bioaccumulation, Kinetics, Calibrations, Tissue analysis, Roots, Aquatic plants.

Heavy metals and other trace contaminants enter surface and groundwater in various ways and adversely affect fauna and flora. Thus, the removal of such impurities is necessary. The heavy metals, in general, .are either precipitated as sulfides or oxides. In a few cases, ion exchangers have also been used to remove metallic ions. For this paper, batch studies were conducted and the uptake of cadmium from water by water hyacinth was investigated for six different concentrations ranging from 0.06-10 mg/L. The daily cadmium uptake for all the concentrations was recorded and the results analyzed. A generalized empirical model and a polynomial model were proposed for the kinetics of cadmium removal. Both models were verified and found to work satisfactorily. Different parts of the plants were also analyzed for cadmium concentration. The cadmium is absorbed by the roots and translocated to different parts of the plants. Maximum cadmium levels were found in the roots of the plants which showed no sign of decay at concentrations as high as 10 mg/L. In addition, the parameters for the continuous operation of a water hyacinth pond were determined. (Author's abstract)
W87-07499

BACTERIAL DIE-OFF IN WASTE STABILIZATION PONDS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
H. Z. Sarikaya, and A. M. Saatci.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 366-382, April 1987. 6 fig, 3 tab, 33 ref.

Descriptors: *Model studies, *Stabilization ponds, *Waste disposal, *Wastewater treatment, *Bacterial physiology, Calibrations, Coliforms, Bacteria, Equations, Ponds.

A rate model was given for the bacterial die-off in waste stabilization ponds. Die-off rate has been expressed as the sum of die-off rate in the dark and the die-off due to light. The proposed rate model has been calibrated and verified by using the results of beaker experiments and coliform removal data found in the literature for the pilot and full-scale waste stabilization ponds. Solutions of the rate equation are presented for both vertically mixed and vertically stagnant ponds. The significant effect of the pond depth on the bacterial removal rates is shown and illustrated. (Author's abstract)
W87-07500

PERMEATE QUALITY OF ULTRAFILTRATION PROCESS,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
A. C. Chao, and S. Tojo.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 383-394, April 1987. 8 fig, 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Model studies, *Ultrafiltration, *Fisheries, Organic solutes, Membrane processes, Molecular weight, Pores, Distribution, Calibrations.

A mathematical model for calculating the efficiency of the ultrafiltration process in removing nonspherical organic solutes from fishery processing wastewaters is presented. The model relating membrane removal efficiency to membrane pore size originally proposed for spherical organic solutes has been modified for nonspherical macromolecular solutes. The concept of equivalent molecular weight was used to treat nonspherical solutes as spherical solutes. The mathematical model assumes that nonspherical organic solutes having a given average molecular weight can be assumed to consist of spherical molecules of different effective molecular weights. Magnitudes of the effective molecular weights represent the difficulty of the solutes to pass through the membrane pore and, hence, the difficulty of removing them. A Gaussian normal pattern is assumed for the distribution of the effective molecular weights. The validity of the effective molecular weight concept is verified by close fits of the calculated results to laboratory data. (Author's abstract)
W87-07501

BIOMASS DETERMINATIONS IN BIOPHYSICAL TREATMENT SYSTEMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
J. R. Schultz.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 395-406, April 1987. 3 fig, 3 tab, 4 ref.

Descriptors: *Biomass, *Biological wastewater treatment, *Wastewater treatment, *Analytical methods, Ignition, Nitric acid, Sludge, Activated carbon, Effluents, Process control, Suspended solids.

An experimental program was conducted to evaluate the relative accuracy of differential ignition and nitric acid solubilization methods for determining the amount of biomass in activated sludge to which powdered activated carbon was added. The results showed the nitric acid method gave better results over a wider range of carbon and biomass concentrations. The nitric acid method was then used in an additional study to determine the ratio of carbon to biomass solids in both the mixed liquor and effluent from a bench scale reactor. The results of this study indicated that there was little difference in the carbon to biomass ratios and supports the concept that solids residence times determined with total suspended solids can be used to control process operation. (Author's abstract)
W87-07502

HYDRAULICS OF PARTIALLY FILLED EGG SEWERS,
Detroit Water and Sewerage Dept., MI.
For primary bibliographic entry see Field 8B.
W87-07503

UNSTEADY-STATE BIOFILM KINETICS,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
A. P. Annachhatre, and P. Khanna.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 429-433, April 1987. 1 fig, 10 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Biofilms, Kinetics, Substrates, Estimating.

A number of models have been put forth in recent years to delineate biofilm kinetics during steady-state and unsteady-state conditions in fixed film systems. Steady-state biofilm kinetics fails to predict the performance of new fixed film facilities during the start-up period. This necessitates in-depth analysis of unsteady-state biofilm kinetics. However, the variation of biofilm thickness with respect to the substrate flux across it during the growth phase of biofilm has not been addressed hereto. Accordingly, this technical note presents a relationship between the rate of biofilm growth and the substrate flux across the biofilm to enable estimation of biofilm thickness and maturation time. A single substrate model is presented to facilitate estimation of unsteady-state biofilm thickness and the time required for the biofilm to reach a steady state value. Effects of long term fluctuations in hydraulic load on the biofilm thickness can also be predicted by the model. (Alexander-PTT)
W87-07504

TREATMENT OF A LANDFILL LEACHATE IN POWDERED ACTIVATED CARBON ENHANCED SEQUENCING BATCH BIOREACTORS,
Occidental Chemical Corp., Grand Island, NY.
For primary bibliographic entry see Field 5G.
W87-07530

PILOT-SCALE DEMONSTRATION OF THE MODAR OXIDATION PROCESS FOR THE DESTRUCTION OF HAZARDOUS ORGANIC WASTE MATERIALS,
CECOS International, Inc., Buffalo, NY.
C. N. Staszak, K. C. Malinowski, and W. R. Killilea.
Environmental Progress ENVPDI, Vol. 6, No. 1, p 39-43, February 1987. 3 fig, 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Organic wastes, *Hazardous materials, *MODAR Oxidation Process, Oxidation process, Wastewater oxidation, Wastewater, Oxidation, Field tests, MODAR Oxidation Process, Critical point, Organic compounds, Detection limits, Contaminants.

CECOS International, Inc., a hazardous waste treatment and disposal firm headquartered in Buffalo, New York, and MODAR, INC. of Houston, Texas, conducted a field, pilot-scale demonstration of the MODAR Oxidation Process for the destruction of hazardous organic waste materials in 1985. The MODAR Oxidation Process utilizes water at conditions above its critical point (647 K and 22.1 MPa) as the reaction medium for the oxidation of organic materials. The products of this oxidation, for a typical organic material, are carbon dioxide and water. Any halogen present as part of the organic matrix is converted to its halo-acid form. Two waste streams were destroyed in the field tests. These were an aqueous-based waste contaminated with several organic EPA priority pollutants, and an organic transformer dielectric fluid contaminated with polychlorinated biphenyls (PCBs). In both tests, water constituent concentrations in liquid and gas process effluents were below analytical detection limits. Destruction efficiencies based on influent concentrations and the reported detection limits were greater than 'four nines'. The results of the demonstration showed the process' ability to destroy toxic and persistent organic contaminants in liquid wastestreams without producing hazardous by-products. (Author's abstract)
W87-07531

CONSUMPTION OF POND WATER THROUGH PARTIAL LIMING: RECENT EXPERIENCE,
Agrico Chemical Co., Donaldsonville, LA.
C. W. Weston.
Environmental Progress ENVPDI, Vol. 6, No. 1, p 62-66, February 1987. 8 fig, 2 tab.

Descriptors: *Wastewater treatment, *Liming, *Acidic water, Wastewater, Industrial wastewater, Ponds, Phosphorus compounds, Fluorides, Acidity, Contaminants, Neutralization.

Contaminated, acidic cooling and gypsum pond waters associated with wet-process phosphoric acid production can be treated using a partial lime process. The treatment largely removes the fluoride component, giving a treated water which is suitable for use in the phosphate rock wet grinding circuit; a majority of the phosphate component of the pond water is thereby directly recovered. Although the acidity of the contaminated water is only partially neutralized during treatment, phosphate rock added to the grinding mill contains sufficient carbonate to give a ground rock slurry of low corrosivity. This process has been used successfully during the last four years at Agrico Chemical Company's Faustina Plant to manage occasional water balance problems resulting from high rainfall. (Author's abstract)
W87-07532

PUTTING THE LID ON CANNERY WASTES,
M. Ralston.
Engineering News - Record ENREAU, Vol. 218, No. 1, p 20-21, January 1987.

Descriptors: *Food-processing wastes, *Wastewater management, *Irrigation, *Waste storage, *Seasonal variation, *Wastewater renovation, *California, *Land disposal, *Wastewater treatment, Industrial wastes, Storage, Water quality standards, Ponds, Oxidation ponds, Filters, Trickling filters, Costs, Capital costs, Maintenance costs, Operating costs, Biochemical oxygen demand, Suspended solids.

Modesto, California is attempting to meet effluent treatment standards through an innovative combination of wastewater reclamation and winter river discharge. Problems are compounded by seasonal cannery wastes that are very high in biochemical oxygen demand and suspended solids. The $60 million, 57 mgd system adapts an existing oxidation pond system and adds to deep-media trickling filters to process sewage wastes after primary treatment. The effluent can be used for irrigation of pasture and forage crops, and on completion will meet federal secondary standards for river discharge in the winter. The two storage ponds, still under construction, are scheduled for completion in July 1987. Even without the ponds, the new system reduced the 700 mg/l BOD almost to the state irrigation standard of 50 mg/l. The system calls for the excavation of three deep pits in each oxidation pond for settling and long-term anaerobic decomposition. Hydrogen sulfide and odors that are generated are controlled by pumping a layer of highly oxygenated water from one of the effluent storage ponds across the top of the pit areas. While capital costs are comparable to those for conventional secondary treatment, operation and maintenance costs are expected to be much lower, and the city will receive income from leases on the irrigated property. (Doria-PTT)
W87-07547

SULFATE-REDUCTION IN THE ANAEROBIC DIGESTION OF ANIMAL WASTE,
Yamagata Univ. (Japan). Lab. of Applied Microbiology.
A. Ueki, K. Matsuda, and C. Ohtsuki.
Journal of General and Applied Microbiology JGAMA9, Vol. 32, No. 2, p 111-123, 1986. 7 fig, 2 tab, 36 ref.

Descriptors: *Wastewater treatment, *Oxidation, *Sulfates, *Chemical reactions, *Anaerobic digestion, *Animal wastes, *Biological wastewater treatment, Wastes, Biodegradation, Digestion, Cattle, Hydrogen, Chloroform, Methane, Hogs.

The relationship between sulfate reduction and the oxidation of various intermediates of anaerobic digestion of animal waste was investigated by incubating cattle waste anaerobically in the presence or absence of sulfate. Propionate oxidation was strongly accelerated by the addition of sulfate, but acetate oxidation was not affected. Lactate, butyrate, and ethanol were oxidized rather rapidly irrespective of the presence of sulfate. Hydrogen gas stimulated both sulfate reduction and methanogenesis, but delayed the oxidation of fatty acids. When methanogenesis was inhibited by the addition of chloroform in the presence of sulfate, the sulfate was ordinarily reduced, while the acetate concentration increased. It was concluded that the contribution of acetate as an electron donor for sulfate reduction was very low in cattle waste. Sulfate reduction in pig waste and a ditch sediment was also investigated for comparison. In both pig wastes studied, propionate oxidation was strongly dependent on sulfate reduction. The propionate oxidation and sulfate reduction in ditch sediment had the same relationship as that in the animal waste. (Author's abstract)
W87-07571

GROWTH CHARACTERISTICS OF BATCH-CULTURED ACTIVATED SLUDGE AND ITS PHOSPHATE ELIMINATION CAPACITY,
Fermentation Research Inst., Yatabe (Japan).
K. Nakamura, and M. Dazai.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 5, p 433-439, October 1986. 7 fig, 1 tab, 18 ref.

Descriptors: *Activated sludge, *Activated sludge process, *Growth, *Culturing techniques, *Phosphates, *Nutrient removal, *Wastewater treatment, Glucose, Accumulation, Sludge, Proteins, Performance evaluation, Oxygen, Dissolved oxygen, Metabolism, Anaerobic conditions, Organic compounds, Bulking sludge.

Growth characteristics of batch-cultured and continuously cultured activated sludge were compared. The batch-cultured activated sludge showed a far higher rate of glucose uptake but a comparable rate of true growth, i.e., growth accompanied by synthesis of nucleic acids and proteins. A large portion of the glucose rapidly taken up is accumulated in sludge in the form of polyglucose and similar polysaccharides, which later decrease gradually with the progress of DNA, RNA, and protein synthesis. A decline in dissolved oxygen was observed upon uptake of glucose as a result of rapid oxygen absorption. At the same time, certain metabolic functions were found to develop under anaerobic conditions, including an organics uptake system accompanied by phosphate release. This development leads to the increase in the amount of polyphosphate in sludge, while the rapid uptake of organics not directly conjugate with growth correlates with bulking suppression. (Author's abstract)
W87-07577

NEW TREATMENT OF SEWAGE SLUDGE BY DIRECT THERMOCHEMICAL LIQUEFACTION,
National Research Inst. for Pollution and Resources, Kawaguchi (Japan).
A. Suzuki, S. Yokoyama, M. Murakami, T. Ogi, and K. Koguchi.
Chemistry Letters CMLTAG, No. 9, p 1425-1428, September 1986. 4 fig, 1 tab, 5 ref.

Descriptors: *Sludge disposal, *Thermochemical liquefaction, *Sodium carbonate, Wastewater treatment, Performance evaluation, Nitrogen, Energy, Wastewater, Municipal wastewater, Sludge, Oil.

Direct thermochemical liquefaction, previously studied for liquid fuel production, was applied to sewage sludge in an attempt to develop a new method for sludge disposal. Raw sludge containing a mixture of primary and waste-activated sludge from a sewage facility was dewatered to 7% moisture content. Experiments were carried out using a 300 ml autoclave. Heavy oil yield increased with increasing reaction temperature, approaching a maximum at 300 C. Conversion yield of solid residue decreased as temperature increased, approaching a minimum at above 300 C. Heavy oils contained 67-70% carbon, 7-9% hydrogen, and 21-25% oxygen; heating values were 31-33.5 MJ/kg, and average molecular weights were about 370 over the temperature range 250-340 C. The relationship between energy consumption ratio (ECR), energy yield, and reaction temperature was investigated. The liquefaction process operated above 275 C was found to be a net energy producer, because the ECR is less than unity above that temperature. The ECR has a minimum value at 300 C, while energy yield increases as the reaction temperature increases. Therefore, the process operated at 300 C is most efficient. It is concluded that the treatment of sewage sludge by direct thermochemical liquefaction could be a profitable alternative means for sludge disposal. (Doria-PTT)
W87-07585

BEER AND BIOMASS,
Bechtel Ltd., London (England).
M. W. Askew.
Mechanical Engineering MEENAH, Vol. 108, No. 12, p 44-48, December 1986.

Descriptors: *Wastewater treatment, *Food-processing wastes, *Beer, *Biomass, *Breweries, *Sludge disposal, *Aerobic digestion, *Land disposal, Bechtel, Biodegradation, Industrial wastes, Digestion, Sludge digestion, Sludge, Costs, Sludge drying, Biological wastewater treatment, Carbon dioxide, Capital costs, Cost analysis.

At the wastewater treatment plant for three major breweries in Tadcaster, northern England, the London division of Bechtel is demonstrating a novel biochemical process for managing the surplus organic sludges produced by these facilities. The system is expected to reduce the breweries' disposal costs by 60%. Demonstration studies were conducted on the effects of aerobic digestion on sludge management problems. The reactor was an uninsulated vessel designed for operation in the mesophilic mode. It can handle 80 metric tons of sludge, with 20 cubic meters of roofed head space for foam development and off-gas collection. Continuous recirculation through a pumped system was used for mixing and aeration. Solids content achieved in dewatered sludge exceeded 18% weight per volume. The product cake has been stacked up to 1.32 meters in the open without slumping and without reabsorbing significant amounts of water. None of the cakes was malodorous. Samples contain more than 33% protein, and can possibly be used in animal feeds or fertilizer. Initial estimates of total capital cost favor the aerobic over the anaerobic approach, at $750,000 vs. $1.8 million. Revenue costs marginally favor aerobic stabilization. (Doria-PTT)
W87-07586

IMMOBILIZED ALGAE: A REVIEW,
Hatfield Polytechnic (England). School of Natural Sciences.
P. K. Robinson, A. L. Mak, and M. D. Trevan.
Process Biochemistry PRBCAP, Vol. 21, No. 4, p 122-127, August 1986. 1 tab, 60 ref.

Descriptors: *Cell immobilization, *Algae, *Reviews, *Biological wastewater treatment, *Bioaccumulation, *Wastewater treatment, Biological treatment, Tertiary wastewater treatment, Chlorophyta, Diatoms, Filters, Percolating filters, Ammonium, Phosphates, Scenedesmus, Hydrocarbons, Chlorinated hydrocarbons, Performance evaluation, Toxicity, Polymers, Algal growth, Metabolism.

The state of the art of research on algal cell immobilization is reviewed, including studies on both the eukaryotic algae and the prokaryotic cyanobacteria. Research areas include biocatalysis, energy production, co-immobilized systems to provide oxygen or reduced NADP for heterotrophic components, bioaccumulation of waste materials, and prolonging the longevity of cultures. Topics discussed include current uses, effects of immobilization on growth, physiology, and productivity, and future prospects. Two examples are presented in the area of waste accumulation. (1) Immobilized algae have been used specifically for the uptake of ammonium and orthophosphate. Immobilized Scenedesmus has been found to be capable of removing 90% of the ammonium (within 4 h) and 100% of the phosphate (within 2 h) from a typical effluent, suggesting possible uses in the tertiary treatment of wastewaters. (2) A study of bioaccumulation of the polychlorinated hydrocarbon chlordecone demonstrated that immobilized Prototheca can remove hydrocarbon from solution about as efficiently as activated charcoal; this ability was found to reside in killed cells and in cell wall components as well as in viable cells. (Doria-PTT)
W87-07588

5E. Ultimate Disposal Of Wastes

BACTERIAL QUALITY OF RUNOFF FROM MANURED AND NON-MANURED CROPLAND,
Department of Agriculture, Ottawa (Ontario). Animal Research Centre.
For primary bibliographic entry see Field 5B.
W87-06653

MINERALIZATION AND VOLATILIZATION OF POLYCHLORINATED BIPHENYLS IN SLUDGE-AMENDED SOILS,

New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 5B.
W87-06720

DECOMPOSITION OF FRESH AND ANAEROBICALLY DIGESTED PLANT BIOMASS IN SOIL,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W87-06721

METAL ACCUMULATION IN CORN AND BARLEY GROWN ON A SLUDGE-AMENDED TYPIC OCHRAQUALF,
Kearney (A.T.), Inc., Alexandria, VA.
For primary bibliographic entry see Field 5B.
W87-06722

REVEGETATION AND MINESOIL DEVELOPMENT OF COAL REFUSE AMENDED WITH SEWAGE SLUDGE AND LIMESTONE,
Louisiana Agricultural Experiment Station, Baton Rouge.
R. E. Joost, F. J. Olsen, and J. H. Jones.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 65-68, January-March 1987. 2 fig, 6 tab, 23 ref.

Descriptors: *Soil amendments, *Sludge disposal, *Land disposal, *Forages, *Grasses, *Mining wastes, *Limestone, Soil chemistry, Field tests, Survival, Pores, Crop yield, Bioaccumulation, Heavy metals, Toxicity, Tissue analysis.

A study was conducted at Peabody Coal Company's Will Scarlet Mine in southern Illinois to evaluate the effectiveness of deep incorporation of dried sewage sludge and/or limestone to ameliorate acid coal refuse (gob) for establishment and survival of three forage grasses. Dried sewage sludge and/or limestone were applied at 10 rates throughout the profile of trenches opened (30 or 60 cm) by a cable trencher. Subplots of reed canarygrass (Phalaris arundinacea L.), tall fescue (Festuca arundinacea Schreb.), and redtop (Agrostis alba L.) were established in September 1980. Analysis of soil chemical and physical changes over time indicated that organic matter applied in the sewage sludge decreased by 35% 2 yr after the plots were established, while the proportion of sand-size waterstable aggregates increased over the same period. The proportion of large pores increased in the high rate sewage sludge plots over that of lime-treated plots. Coal refuse pH increased from 2.7 in the unamended gob to 4.4 to 5.2 with all treatments but the two lower lime rates. All treatments maintained grass stands over 4 yr with the exception of the 225 Mg sludge/ha plus 45 Mg limestone/ha mixture at 60 cm. Reed canarygrass invaded adjacent plots and was more persistent than the other grasses. Mean herbage yield of the grasses exceeded 4.0 Mg/ha on all treatments. Tissue accumulation of heavy metals was not a problem. Tissue NO3 levels were considered toxic for ruminants the first 3 yr, but decreased significantly over time. Coal refuse disposal sites can be revegetated without the use of soil cover by application of sewage sludge or limestone. (Author's abstract)
W87-06725

CHARACTERIZATION OF IRON AND ZINC IN ALBUQUERQUE SEWAGE SLUDGE,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5A.
W87-06729

SOIL-WATER PROPERTIES AS AFFECTED BY TWELVE ANNUAL APPLICATIONS OF CATTLE FEEDLOT MANURE,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2G.
W87-06791

INCLINED DENSE JETS IN FLOWING CURRENT,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06835

WAVE ACTION IN PUMPING STATION STORM OVERFLOW,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W87-06836

INSTALLATION RESTORATION PROGRAM, PHASE I: RECORDS SEARCH REESE AFB, TEXAS.
Radian Corp., Austin, TX.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as AD-A144 351.Price codes: A11-PC in papercopy, A01-MF in microfiche. Air Force Report No. DCN 84-227-001-01, June 1984. 253 p, 26 fig, 11 tab, 11 append.

Descriptors: *Waste management, *Waste disposal, *Reese Air Force Base, *Path of pollutants, Hazardous wastes, Landfills, Domestic wastes, Data interpretation, Fate of pollutants.

This report was prepared to aid in implementing the Air Force Restoration Program at Reese AFB. It is DoD policy to identify and fully evaluate suspected problems associated with past hazardous waste management practices on DoD facilities and to control the migration of hazardous constituents from such facilities that could endanger health and welfare. Major findings include: (1) Since 1941, many hazardous and potentially hazardous wastes have been generated by industrial shop operations at Reese AFB; (2) Fire training exercises have provided a means of disposal of waste Avgas, oils and lubricants, and miscellaneous combustible materials since at least the 1950's; and (3) Landfills and land spreading areas have been used for waste disposal since the base was constructed. Most of the materials disposed have been construction and domestic wastes, although some hazardous wastes were reportedly landfilled in the past. Review of the comprehensive data base assembled for this study resulted in the identification of 36 sites of potential contamination at Reese AFB. Ten of these 36 preliminary sites were ranked using the Hazard Assessment Rating Methodology (HARM) based on their potential for migration of hazardous constituents. (Lantz-PTT)
W87-06843

DESIGN IMPROVEMENTS ON SHALLOW-LAND BURIAL TRENCHES FOR DISPOSING OF LOW-LEVEL RADIOACTIVE WASTE,
Texas Univ., Austin.
E. S. Takamura, J. M. Salsman, and J. O. Ledbetter.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-014079, Price codes: A02 in paper copy, A01 in microfiche. Dept of Energy Report No. CONF-840627--8, (1984). 17 p, 4 fig, 13 ref.

Descriptors: *Design criteria, *Land disposal, *Waste disposal, *Radioactive wastes, *Trenches, *Path of pollutants, Regulations, Clays, Sands, Vadose water, Monitoring, Groundwater quality, Infiltration, Leachates.

The lack of success of closed low-level radioactive waste disposal sites has prompted the federal government to increase regulation of these facilities. In order to meet these increased requirements, several waste trench improvements are necessary. These improvements to the trench include sandy-clay caps, compacted sandy-clay bottoms, in-place geophysical instruments and vadose zone sampling equipment, and concrete sidewalls. These design improvements should increase the containment of the radionuclides by decreasing the waste contact with infiltrating groundwater. The design improves on the monitoring and sampling methods for detecting radionuclides transported through the leachate or gas effluent streams. (Author's abstract)
W87-06845

WATER FOR SUBSURFACE INJECTION.
American Society for Testing and Materials, Philadelphia, PA.
Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. 149 p. Edited by J. L. Johnson, J. R. Stanford, C. C. Wright, and A. G. Ostroff.

Descriptors: *Subsurface injection, *Industrial water, *Oil industry, *Symposium, Oil fields, Filtration, Corrosion, Water quality, Water treatment, Process water.

Maintaining petroleum production in declining fields is of ever increasing importance in meeting the world's energy requirements. Water injection into the oil bearing reservoir can substantially increase the volume of produced oil. Some fields are at their economic limit in waterflooding, and enhanced recovery methods are being initiated. Throughout an oil field's productive life, studies are made of the produced and injected water regarding suspended solids, scale formation, bacteria contamination, and corrosivity. The papers presented offer practical information for the waterflooded operator. The symposium was divided into four basic area: (1) filtration , (2) corrosion and quality, (3) reservoir considerations, and (4) treatment methods. The project design engineers must consider these items in order to develop and maintain a sound, trouble-free water injection system. (See also W87-06889 thru W87-06898) (Lantz-PTT)
W87-06888

INVESTIGATION OF INJECTION PROBLEMS OF A PRODUCED WATER DISPOSAL SYSTEM WITH EMPHASIS ON REDOX POTENTIAL MEASUREMENT FOR SOLVING INJECTION PROBLEMS IN THE FIELD,
Nalco Chemical Co., Sugar Land, TX.
P. J. Stone.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 3-14, 5 fig, 7 tab, 5 ref.

Descriptors: *Injection water, *Oil fields, *Aeration, *Industrial water, *Waste disposal, Chemical precipitation, Calcium carbonate, Iron oxide, Oxygen, Process water, Redox potential.

Scale inhibitors can solve calcium carbonate deposit problems, but not aeration problems. Aeration of produced water and consequent iron oxide precipitation in the oil field is a common mechanical failing that can lead to serious loss of injectivity and even complete loss of injection wells being used for disposal or water flooding. Redox potential has been successfully measured in the field and, in one case, has correlated well with suspended iron oxide and oxygen concentration measurements. (See also W87-06888) (Author's abstract)
W87-06889

OFFSHORE FILTRATION TESTING AND ANALYSIS OF SEAWATER FOR OIL-FIELD INJECTION,
Serck Water Processing, Gloucester (England).
For primary bibliographic entry see Field 5A.
W87-06893

VARIOUS METHODS USED IN EVALUATING THE QUALITY OF OIL-FIELD WATERS FOR SUBSURFACE INJECTION,
N.L. Treating Chemicals Lab., Houston, TX.
For primary bibliographic entry see Field 5A.
W87-06894

MONITORING ACROLEIN IN NATURALLY OCCURRING SYSTEMS,
Magna Corp., Santa Fe Springs, CA.
For primary bibliographic entry see Field 5A.
W87-06896

SEDIMENT TOXICITY, CONTAMINATION, AND MACROBENTHIC COMMUNITIES NEAR A LARGE SEWAGE OUTFALL,
Environmental Research Lab.-Narragansett, Newport, OR. Mark O. Hatfield Marine Science Center.
For primary bibliographic entry see Field 5C.
W87-06923

LEACHING EXPERIMENTS ON COAL PREPARATION WASTES: COMPARISONS OF THE EPA EXTRACTION PROCEDURE WITH OTHER METHODS,
Los Alamos National Lab., NM.
R. C. Heaton, P. L. Wanek, E. F. Thode, E. J. Cokal, and P. Wagner.
Available from the National Technical Information Service, Springfield, Virginia. 22161, as DE81-023983. Price codes: AO2-PC in paper copy, AO1-MF in microfich.Report No. LA-8773-SR, EPA-600/7-81-072, April 1981. 23 p, 1 fig, 10 tab, 6 ref.

Descriptors: *Analytical methods, *Pollutant identification, *Waste disposal, *Leaching, *Coal mines, *Industrial wastes, *Illinois, Arsenic, Minerals, Barium, Cadmium, Chromium, Mercury, Silver, Lead, Selenium, Iron, Aluminum, Nickel, Manganese, Zinc, Copper, Hydrogen ion concentration, Heavy metals.

Mineral wastes from seven coal preparation plants, located in the Illinois Basin, the Appalachian Region, and the West were leached in accordance with the EPA extraction procedure published in the Federal Register dated May 19, 1980. This is one of the tests required for the classification of solid wastes under RCRA. When examined according to the procedures set forth in the Federal Register, all of the coal waste leachates had trace element concentrations below the maximum set by EPA. Results of the EPA leaching procedure compare favorably with those of these leaching experiments for those elements which were analyzed (Ag, As, Ba, Cd, Cr, Hg, Pb, Se). However, it is noted that coal wastes release substantial quantities of other trace elements not included in the protocols at the present time (Fe, Al, Ni, Mn, Zn, Cu). In addition, the requirement that the test leachate be maintained at pH < or = to 5 has the effect of establishing an abnormal environment for those wastes that are neutral or alkaline. (Author's abstract)
W87-06945

MUNICIPAL WASTEWATER SLUDGE COMBUSTION TECHNOLOGY.
Environmental Protection Agency, Cincinnati, OH. Center for Environmental Research Information.
Technomic Publishing Company, Inc., Lancaster, PA. (1984). 177 p.

Descriptors: *Municipal wastewater, *Sludge utilization, *Sludge combustion, *Wastewater disposal, *Waste disposal, Incineration, Sludge management, Sludge dewatering.

Described and evaluated are the various municipal sludge combustion systems. Emphasis is on the necessity for considering and evaluating the costs involved in the total sludge management train, including dewatering, combustion, air pollution control, and ash disposal processes. Many different, plausible schemes exist for treating municipal wastewater treatment plant sludge, but no single method is appropriate for all municipalities. Sludge properties, project size, and location are the primary considerations that enter into the identification of prudent approaches to sludge management. Common to all is the need to concentrate the collected solids and then to process them to minimize any adverse impact on the environment in ultimate disposal. Recent developments in more efficient solids dewatering processes and advances in combustion technology have renewed an interest in the use of high temperature processes for specific applications. High temperature processes should be considered where available land is scarce, stringent requirements for land disposal exist, destruction of toxic materials is required, or the potential exists for recovery of energy, either with wastewater solids alone, or combined with municipal refuse. High temperature processes have several potential advantages over other methods: (1) maximum volume reduction. Reduces volume and weight of wet sludge cake by approximately 95%, thereby reducing disposal requirements; (2) detoxification. Destroys or reduces toxics that may otherwise create adverse environmental impacts; and (3) energy recovery. Potentially recovers energy through the combustion of waste products, thereby reducing the overall expenditure of energy. (Lantz-PTT)
W87-06946

ROLE OF THE UNSATURATED ZONE IN RADIOACTIVE AND HAZARDOUS WASTE DISPOSAL.
Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. 339 p. Edited by James W. Mercer, P. S. C. Rao, and I. Wendell Marine.

Descriptors: *Aeration zone, *Radioactive wastes, *Hazardous wastes, *Waste dumps, *Waste disposal, *Hazardous wastes, *Path of pollutants, Physical properties, Chemical processes, Wastewater disposal, Mathematical analysis, Model studies, Field tests, Nevada, South Carolina, New Jersey.

The majority of hazardous and low-level radioactive wastes that are placed in the subsurface are affected by the physical and chemical processes active in the unsaturated zone. This book deals with problems associated with waste disposal practices, and focuses on the uses of laboratory analyses, field observations, and numerical and analytical calculations. Topics include policy, modeling, statistical techniques, liners, and field applications. Field sites included the Nevada Test Site, Barnwell, South Carolina, and the Price Landfill, near Atlantic City, New Jersey. (See also W87-06948 thru W87-06964) (Lantz-PTT)
W87-06947

NRC-FUNDED STUDIES ON WASTE DISPOSAL IN PARTIALLY SATURATED MEDIA,
Nuclear Regulatory Commission, Washington, DC. Low-Level Waste Licensing Branch.
D. L. Siefken, and R. J. Starmer.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 1-10, 3 tab, 4 ref.

Descriptors: *Hazardous wastes, *Waste disposal, *Saturated soils, *Path of pollutants, *Radioactive wastes, Uranium, Field tests, Model studies, Flow profiles, Permeability coefficient, Infiltration, Leaching, Hydraulic conductivity.

The Division of Waste Management within the Office of Nuclear Material Safety and Safeguards encompasses three distinct types of commercial radioactive waste disposal: high-level, low-level, and uranium recovery wastes. Technical assistance projects, through the Office of Nuclear Material Safety and Safeguards, and research projects, through the Office of Nuclear Regulatory Research, provide technical support to NRC staff in a wide range of areas related to waste disposal in partially saturated media. These studies include such diverse areas as: field studies and modeling of flow and transport in partially saturated porous media or fractured rock; laboratory studies and modeling of changes in unsaturated hydraulic conductivity due to consolidation or changes in moisture content and temperature; assessment of methodologies for paleohydrologic evaluation; laboratory and field testing of capillary (wick-effect) barriers to infiltration; field studies of the relationship between wetting fronts and leaching; field studies and modeling of geochemical processes affecting the transport of reactive radioactive solutes; field studies involving hydraulic monitoring of flow user tracers; field studies of the effects of subsidence on infiltration-limiting trench cap covers; field studies of vapor phase releases; and assessment of unsaturated media at the Nevada Test Site as alternatives for geologic disposal of high-level wastes. (See also W87-06947) (Lantz-PTT)
W87-06948

MODELING OF MOISTURE MOVEMENT THROUGH LAYERED TRENCH COVERS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W87-06949

MODEL TO SIMULATE INFILTRATION OF RAINWATER THROUGH THE COVER OF A RADIOACTIVE WASTE TRENCH UNDER SATURATED AND UNSATURATED CONDITIONS,
Office of Radiation Programs, Washington, DC.
For primary bibliographic entry see Field 5B.
W87-06950

ROLE OF PARTIALLY SATURATED SOIL IN LINER DESIGN FOR HAZARDOUS WASTE DISPOSAL SITES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
D. B. McWhorter, J. D. Nelson, T. A. Shepherd, and R. E. Wardwell.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 81-100, 7 fig, 1 tab, 10 ref.

Descriptors: *Hazardous wastes, *Saturated flow, *Saturated soils, *Soil water, *Waste disposal, *Liners, Disposal sites, Flow profiles, Aquifers, Economic aspects, Water quality control, Hydraulic conductivity.

Disposal areas containing toxic or hazardous materials are often constructed with low permeability liners to minimize the seepage losses from the impoundments. In many areas of the world, these disposal areas are located on or in natural formations which are several meters above the groundwater level. In such cases, the foundation material between the impoundment and the phreatic surface of the aquifer is partially saturated. Estimation of seepage losses, required to assess potential environmental impacts and to provide input for water balance computations, should be based on the flow through partially saturated porous media since conventional saturated methods do not apply. A method is presented which assists in selecting an economic but environmentally sound liner system by incorporating the flows through partially saturated foundation strata and by analyzing partially saturated and saturated conditions behind the wetting front. Design charts were prepared for a specific case and procedures outlined to derive these for other conditions and to modify them for a variety of other situations. Use of this technique and the analysis of the partially saturated flow regimes was applied to the design of the liner material and thickness, but couid easily be adapted to the evaluation of other parameters influencing the resulting environmental impact of a hazardous-waste disposal area. (See also W87-06947) (Lantz-PTT)
W87-06953

COMPOSITION, DENSITY AND FABRIC EFFECTS ON BULKY WASTE CAPILLARY RETENTION CHARACTERISTICS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W87-06956

LABORATORY ANALYSIS OF WATER RETENTION IN UNSATURATED ZONE MATERIALS AT HIGH TEMPERATURE,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2G.
W87-06957

NUCLEAR WASTE ISOLATION IN THE UNSATURATED ZONE OF ARID REGIONS,
Lawrence Berkeley Lab., CA.
H. A. Wollenberg, J. S. Y. Wang, and G. Korbin.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Sci-

ence Publishers, Ann Arbor, Michigan. 1983. p 195-210, 7 fig, 1 tab, 17 ref. NRC Interagency Agreement DOE 50-80-97, NRC FIN B 3040-0, and DOE Contract DE-AC03-76SF00098.

Descriptors: *Hazardous wastes, *Waste disposal, *Arid lands, *Radioactive wastes, *Aeration zone, *Waste isolation, Vadose zone, Topography, Soil properties, Rocks, Geohydrology, Radionuclides.

There are several topographic and lithologic combinations in the vadose zone of arid regions that may lend themselves to waste isolation considerations. In some cases, topographic highs such as mesas and interbasin ranges--comprised of several rock types, may contain essentially dry or partially saturated conditions favorable for isolation. The adjacent basins, especially in the far western and southwestern U.S., may have no surface or subsurface hydrologic connections with systems ultimately leading to the ocean. Some rock types may have the favorable characteristics of very low permeability and contain appropriate minerals for the strong chemical retardation of radionuclides. Environments exhibiting these hydrologic and geochemical attributes are the areas underlain by tuffaceous rocks, relatively common in the Basin and Range geomorphic province. Adjacent valley areas, where tuffaceous debris makes up a significant component of valley fill alluvium, may also contain thick zones of unsaturated material, and as such also lend themselves to strong consideration as repository environments. In comparing the attributes of waste isolation in the unsaturated zone of arid regions and saturated hydrologic regimes, major advantages and concerns are clearly identifiable in the considerations of transport of radionuclides, thermal effects, and the potential for human intrusion. These are presented in brief in tabular form. Given appropriate study similar comparisons of advantages and concerns of unsaturated and saturated regimes may be made for the considerations of the effects on the waste form and on its surrounding canister and overpack material. Considerations would include the effect of saturated and unsaturated conditions at repository temperature and pressure on corrosion of the canisters, on the leaching of waste forms, and on the mechanical and hydrological integrity of overpack and backfill material. It is concluded that the unsaturated zones in alluvium or tuffaceous rocks of the Basin and Range province are strong candidate environments for consideration as sites for nuclear waste repositories, and as such should be investigated as comprehensively as the other geologic settings presently being considered. (See also W87-06947) (Lantz-PTT)
W87-06960

HYDROGEOLOGICAL INVESTIGATION HAZARDOUS WASTE SITE, ATLANTIC CITY, NEW JERSEY,
International Exploration, Inc., Warminister, PA.
For primary bibliographic entry see Field 5B.
W87-06961

HYDROLOGIC STUDY OF THE UNSATURATED ZONE ADJACENT TO A RADIOACTIVE WASTE DISPOSAL SITE AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA,
Environmental Resources Management, Inc., West Chester, PA.
For primary bibliographic entry see Field 2G.
W87-06963

DREDGED-MATERIAL DISPOSAL IN THE OCEAN.
Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. 299 p. Edited by Dana R. Kester, Bostwick H. Ketchum, Iver W. Duedall, and P. Kilho Park.

Descriptors: *Waste disposal, *Ocean dumping, *Dredging, *Sediment disposal, Harbors, Coastal waters, Case studies, Chemical analysis, Physical analysis, Biological properties, Dumping.

The disposal of dredged material from marine waterways is a long-term problem which must be addressed to maintain marine transportation. The problem exists primarily to the extent that coastal and harbor sediments have been contaminated by pollutants from municipal, shipping, and industrial sources. The problems of contaminated sediment disposal are evident to countries which now must dredge harbors that have accumulated sediments and pollutants during decades of poorly controlled waste disposal in coastal waters. It is important that maritime countries that are presently expanding their industrial activities also consider the risks and costs of contaminated sediment disposal. This book is arranged in parts. The first part is an introductory chapter and two chapters related to the regulatory aspects of contaminated dredged-material disposal as practiced in the United States. A series of case studies provides information on specific aspects of physical and chemical characteristics of dredged material dumpsites in U.S. waters. The third part includes three chapters on biological investigations related to contaminated sediments. Three chapters consider procedures for sediment disposal that are alternatives to dumping material in a mound in open waters. The last chapter examines the present state of knowledge and the areas where further scientific informationis needed. (See also W87-06980 thru W87-06993) (Lantz-PTT)
W87-06979

PROBLEM OF DREDGED-MATERIAL DISPOSAL,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
D. R. Kester, B. H. Ketchum, I. W. Duedall, and P. K. Park.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 3-27, 7 fig, 7 tab, 30 ref. NOAA Grant NA-79-AA-H-00086.

Descriptors: *Sediment disposal, *Dredging, *Waste disposal, *Ocean dumping, Economic aspects, Marine environment, Leaching, Chemical analysis, Bioassays, Water pollution control.

The disposal of dredged material in the ocean is the largest input of waste substances on a mass basis. Existing data are too incomplete to provide a reasonable estimate of dredged-material disposal on a global basis, but it is evident that it is a worldwide practice, and developing countries may be substantial contributors of dredged material to the marine environment. Four approaches were used to characterize dredged material chemically: bulk analysis, the elutriate test, selective chemical leaching, and bioassay tests. The selective chemical leaching provides the most informative assessment of the chemical state of pollutants associated with sediments. The bioassays provide an operational measure of biological effects. A wide range of alternatives may be considered for the disposal of contaminated sediment. In addition to open-water dumping, various types of containment may be feasible either on land or in the marine environment. Economic considerations of dredged-material disposal most often include capital, operating, and transportation costs. The costs associated with dredging operations can span a large range. In New York, the costs in 1976 were about $2 to $3/cu m. The disposal of contaminated sediments in containment sites on land use costs $65/cu m in Japan and in Seattle, Washington. There is a need to obtain sufficient information on the environmental effects of contaminated dredged-material disposal so that the impact on the other uses of the marine environment can be assessed. (See also W87-06979) (Author's abstract)
W87-06980

DREDGED-MATERIAL OCEAN DUMPING: PERSPECTIVES ON LEGAL AND ENVIRONMENTAL IMPACTS,
National Wildlife Federation, Washington, DC.
K. S. Kamlet.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 29-70, 3 fig, 3 tab, 65 ref.

Descriptors: *Sediments, *Ocean dumping, *Dredging, *Waste disposal, *Water pollution effects, *Legal aspects, Environmental effects, Environment impact statement, Case studies, Chemical analysis, Bioassay, Water pollution control, Research priorities.

The procedures used by regulatory authorities in the United States to determine the environmental impact potential of contaminated dredged material have changed greatly in recent years. From an early reliance on bulk chemical criteria, dredged-material evaluation has evolved through standard elutriate testing, multiphase bioassay tests, and bioaccumulation assessments. The approach currently in vogue relies on interim guidance matrices for evaluating the significance of the bioaccumulation of dredged-material contaminants. Although the early procedures may have tended to exaggerate the potential impacts of some dredged-material constituents (e.g., heavy metals) because they failed to distinguish between biologically available and nonavailable fractions, there is reason to be concerned that present procedures have perhaps swung too far in the opposite direction. These procedures too often assume that effects that cannot be readily measured in short-term laboratory tests or under field conditions either are not occurring or cannot be of environmental significance. And they frequently underestimate the resourcefulness of living things; for example, the ability of microorganisms to alkylate inorganic forms of heavy metals, with resulting enhancement of their toxicity and biological availability. This chapter discusses an array of current and historical dredged-material ocean dumping issues, including the environmental significance of dredged-material disposal in the ocean, alternatives to ocean dumping, research needs, and future problems and prospects. (See also W87-06979) (Author's abstract)
W87-06981

TECHNICAL IMPLEMENTATION OF THE REGULATIONS GOVERNING OCEAN DISPOSAL OF DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5G.
W87-06982

PEARL HARBOR DREDGED-MATERIAL DISPOSAL,
Hawaii Univ., Honolulu.
K. E. Chave, and J. N. Miller.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 91-98, 6 fig, 2 tab.

Descriptors: *Sediments, *Water pollution effects, *Dredging, *Waste disposal, *Pearl Harbor, *Hawaii, Dumping, Zooplankton, Water quality, Shrimp, Copper, Zinc, Chromium, Nickel, Lead, Heavy metals, Environmental effects.

Between 11 April and 31 May 1977, 637,000 cu m of material dredged from the channels and turning basins of Pearl Harbor, Hawaii were dumped at a site approximately 4.6 km south of the entrance to the harbor in 410 m of water. The environmental effects of the dumping were monitored before, during, and after disposal. The bottom at the disposal site is essentially featureless with a slope of about 1:100 to the southeast. Sediments are relatively pure carbonate sands. The water column has a 60-80 m mixed layer with a thermocline, ranging from 25 to 9 C. Water quality is typical of open ocean waters. Zooplankton are typical for Hawaiian waters, being dominated by copepods. The only potentially economic resource in the area is the benthic shrimp Heterocarpus ensifer. The dredged material itself is about 80% silt and clay, the remainder being sand, gravel, and coral rubble. The material is rich in Cu, Zn, Cr, Ni, and Pb with lesser amounts of other heavy metals. During the dump period small amounts of fine material could be detected over a widespread area, whereas coarser materials were limited to within 2 km of the dumpsite. No buildup of dumped material on the bottom could be detected. A surface plume was observed shortly after each dump, but it dispersed rapidly, and an increase in turbidity was observed

near the top of the thermocline. Zooplankton and benthic shrimp were more abundant during dumping than before. In the period of 6 months following the material dumping the fine sediments were dispersed further. The water column was normal. Zooplankton increased in abundance (probably as a result of relocation of the nearby Honolulu sewer outfall). Shrimp abundance was slightly higher also. At no time during the study were elevated concentrations of heavy metals found in either the zooplankton or the benthic shrimp. The dumping of 637,000 cu m of dredged material, 4.6 km offshore, in 410 m of water had no significant environmental effects. (See W87-06979) (Author's abstract)
W87-06983

PRECISION BATHYMETRIC STUDY OF DREDGED-MATERIAL CAPPING EXPERIMENT IN LONG ISLAND SOUND,
Science Applications, Inc., Newport, RI. Ocean Science and Technology Div.
For primary bibliographic entry see Field 5B.
W87-06984

GEOCHEMICAL STUDY OF THE DREDGED-MATERIAL DEPOSIT IN THE NEW YORK BIGHT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
R. Dayal, M. G. Heaton, M. Fuhrmann, and I. W. Duedall.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 123-149, 10 fig, 7 tab, 16 ref.

Descriptors: *Sediments, *Ocean disposal, *Waste disposal, *Dredging, *New York Bight, *Geochemistry, *Path of pollutants, Heavy metals, Dumping, Copper, Mercury, Silver, Cadmium, Iron, Manganese.

The sediments of the New York Bight dredged-material deposit are composed of a wide variety sediment types which can be classified as quartzose and glauconitic sands, muds, sandy muds, gravel intermixed with muds, and artifact material such as coal and fly ash, wood, slag, metal flakes, glass, and so on. Black, sandy mud is characteristic of dumped dredged material whereas glauconitic and gravelly quartzose sands are typical of the natural sediment underlying the deposit and in surrounding areas. Geochemical investigations of the deposit reveal that heavy metals such as Pb, Cu, Ag, Hg, Cd, Fe, and Mn in dredged-material sediments are highly variable and considerably elevated over concentrations observed in sediment outside the deposit and in underlying natural sediment. Compared to metal enrichments reported for other coastal deposits, the enrichments observed in dredged-material sediments are significantly greater. The calculated rates and magnitudes of inputs of metals and organic matter to the New York Bight, via dredged-material dumping, are two to three orders of magnitude higher for Cd and Ag and more than an order of magnitude higher for Pb and Cu than those reported for other naturally deposited coastal sediments. Even Fe and Mn have significant anthropogenic inputs atthe dumpsite. Organic matter and, to a lesser extent, iron and manganese phasesappear to control the distribution of Cu, Pb, Mn, Hg, Cd, and Ag in dredged-material sediments. (See also W87-06979) (Author's abstract)
W87-06985

OCEAN DUMPING OF DREDGED MATERIAL IN THE NEW YORK BIGHT: ORGANIC CHEMISTRY STUDIES,
Energy Resources Co., Inc., Cambridge, MA.
For primary bibliographic entry see Field 5B.
W87-06986

CHANGES IN THE LEVELS OF PCBS IN MYTILUS EDULIS ASSOCIATED WITH DREDGED-MATERIAL DISPOSAL,
Connecticut Univ., Groton. Marine Sciences Inst.
For primary bibliographic entry see Field 5B.
W87-06989

SUBMARINE BORROW PITS AS CONTAINMENT SITES FOR DREDGED SEDIMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
H. J. Bokuniewicz.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 215-227, 3 fig, 21 ref.

Descriptors: *Maine environment, *Borrow pits, *Waste disposal, *Ocean dumping, *Dredging, *New York Harbor, *Sediments, *Sedimentation, Slopes.

Sand-mining operations in New York Harbor have left several large pits on the harbor floor. Two of these were examined. The larger pit has a volume of about 2,500,000 cu m. The pits are typically 7-10 m deeper than the ambient seafloor and have side slopes of between 10 and 25 degrees. Although the harbor floor is sandy, more than 3,000,000 cu m of mud has accumulated naturally in these pits. In the larger pit the layer of mud is up to 1 m thick. The average rate of accumulation is estimated to be between 0.05 and 0.10 m/yr. The technology is available to deposit dredged sediment into the pits. Hopper dredged disposal operation may be used to forecast the short-term behavior of the dredged sediment during the emplacement process. The side slopes of the pits in New York Harbor should be sufficient to prevent the spread of dredged sediment outside of the pit until the pit is about half filled. The dredged-material deposit will have low side slopes (< 3 degrees). The most effective form for the deposit would be truncated cone or pyramid in order to maintain a shallow trough around the inside edge of the pit. While the thickness of the mud deposit is small compared to the depth of the pit, the naturally high sedimentation rate will enhance containment. Alternatively, the surface might be covered, or capped, with sand. (See also W87-06979) (Author's abstract)
W87-06990

SOME ASPECTS OF DEEP OCEAN DISPOSAL OF DREDGED MATERIAL,
Tereco Corp., College Station, TX.
W. E. Pequegnat.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 229-252, 3 fig, 1 tab, 45 ref.

Descriptors: *Sediments, *Dredging, *Ocean dumping, *Waste disposal, Marine waterways, Public opinion, Marine environment, Environmental effects.

The continuing need for maintenance dredging of existing marine waterways and extant plans for future deepening of major ports and harbors indicate that the U.S. Army Corps of Engineers must solve the problem of disposing of increasing amounts of salt-laden dredged material. At the same time public sentiment is growing against placing this material, whether contaminated or not, on land or on the continental shelf. One solution to the problem involves disposing of the material in the deep ocean. After a discussion of why the deep ocean is a good receiving environment for dredged material, there follows a description of the fate and effects of dredged material dumped into the open ocean. Finally, the principal arguments generally raised against deep-ocean disposal are countered, and it is concluded that to dispose dredged material in the deep ocean entails minimal environmental risk. (See also W87-06979) (Author's abstract)
W87-06991

HAVE THE QUESTIONS CONCERNING DREDGED-MATERIAL DISPOSAL BEEN ANSWERED,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
D. R. Kester, B. H. Ketchum, I. W. Duedall, and P. K. Park.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 275-287, 4 tab, 15 ref. NOAA Grant 04-8-MO1-192.

Descriptors: *Ocean dumping, *Waste disposal, *Dredging, *Marine environment, *Sediments, Pollutant identification, Bioassay, Jensen criteria, Chemical analysis, Waste recovery, Environmental effects, Groundwater.

There are four major issues which should be addressed when considering dredged-material disposal in the marine environment: (1) will the environment be degraded; (2) how can contaminated and uncontaminated sediment by distinguished; (3) will the marine food chain be modified; (4) what is the best way to dispose of dredged material. The short-term effects of dredged-material disposal are readily recognized, but the possible long-term effects are more difficult to determine. Four approaches were used to identify contaminated sediment. They are (a) the Jensen criteria, (b) the elutriate test, (c) the liquid-phase, suspended-phase, and solid-phase bioassays, and (d) the State of Connecticut chemical classification. Specific biological effects of contaminated sediment can be recognized, but it is difficult to generalize or predict these effects with existing knowledge. Uncontaminated dredged material should be used as a resource wherever possible. Contaminated dredged material should be disposed of in a containment environment below the level of fresh groundwater. (See also W87-06979) (Author's abstract)
W87-06993

CARBON-14 IN SLUDGE,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
J. R. Fowler, and C. J. Coleman.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as DE84-015774, Price codes: A02 in paper copy, A01 in microfiche. Report No. DPST--83-2001, December 28, 1983. 6 p, 2 tab, 4 ref.

Descriptors: *Waste disposal, *Carbon radioisotopes, *Sludge, *Path of pollutants, *Radioactive wastes, Industrial wastes.

The level of C-14 in high-level waste is needed to establish the amount of C-14 that will be released to the environment either as off-gas from the Defense Waste Processing Facility (DWPF) or as a component of saltstone. Available experimental data confirmed a low level of C-14 in soluble waste, but no data was available for sludge. Based on the processes used in each area, Purex LAW sludge in F-area and HM HAW sludge in H-area, will contain the bulk of any sludge produced by the cladding. Accordingly, samples from Tank 8F containing Purex LAW and Tank 15H containing HM HAW were obtained and analyzed for C-14. These two waste types constitute approximately 70% of the total sludge inventory now stored in the waste tanks. Results from analyses of these two sludge types show: (1) the total C-14 inventory in sludge now stored in the waste tanks is 6.8 Ci; and (2) C-14 releases to the atmosphere from the DWPF will average approximately 0.6 Ci annually at the projected sludge processing rate in the DWPF. (Lantz-PTT)
W87-06995

WATER BUDGET FOR SRP BURIAL GROUND AREA,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5B.
W87-06996

USE OF SHORT-TERM BIOASSAYS TO EVALUATE ENVIRONMENTAL IMPACT OF LAND TREATMENT OF HAZARDOUS INDUSTRIAL WASTE,
Texas Agricultural Experiment Station, College Station.
For primary bibliographic entry see Field 5C.
W87-07003

NEAR-SURFACE GROUNDWATER RESPONSES TO INJECTION OF GEOTHERMAL WASTES,
Idaho Water and Energy Resources Research Inst., Moscow.
S. C. Arnold.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84015139. Price codes: A07 in paper copy, A01 in microfiche. Research Technical Completion Report DOE/ID/12210--T1, June 1984. 138 p, 19 fig, 20 tab, 70 ref. DOE Project DE-AM07-81ID12210.

Descriptors: *Waste disposal, *Geothermal wastes, *Path of pollutants, *Groundwater pollution, *Raft River, *Idaho, *Salton Sea, *California, *Japan, *El Salvador, Groundwater quality, Injection wells, Hydraulic properties, Geohydrology.

Experiences with injecting geothermal fluids have identified technical problems associated with geothermal waste disposal. This report assesses the feasibility of injection as an alternative for geothermal wastewater disposal and analyzes hydrologic controls governing the upward migration of injected fluids. Injection experiences at several geothermal developments are presented. Testing at the Raft River KGRA in Idaho was limited to short-term injection into an interval shallower than the production interval. Results indicated there is hydraulic communication among deep and shallow wells. The potential for substantial upward migration of injected fluids is moderately high. Injection at the Salton Sea KGRA in California was tested by injecting into an interval slightly deeper than the production interval. Problems included high total dissolved solids (TDS) and potential for increased subsidence and induced seismicity. The potential for substantial upward migration of injected fluids is low. Injection at the East Mesa KGRA in California has occurred into an interval similar to the production interval. Problems are similar to those at the Salton Sea KGRA, although TDS are less. The potential for substantial upward migration of injected fluids is low. Injection at the Otake geothermal field in Japan occurs in intervals similar to the production intervals. Problems include a high potential for injected fluids to migrate upward along fractures and silica scaling of wells and equipment. (Author's abstract)
W87-07011

SYSTEMS COSTS FOR DISPOSAL OF SAVANNAH RIVER HIGH-LEVEL WASTE SLUDGE AND SALT,
Savannah River Lab., Aiken, SC.
W. R. McDonnell, and C. B. Goodlett.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84015751. Price codes: A02 in paper copy, A01 in microfiche. DuPont Report No. DP-MS-83-121, (1984). 15 p, 7 tab, 13 ref. DOE Contract DE-AC09-76SR00001.

Descriptors: *Waste disposal, *Cost analysis, *Savannah River Plant, *Economic aspects, *Model studies, *Radioactive wastes, *Sludge, *Salt, Industrial wastes, Waste management.

A systems cost model was developed to support disposal of defense high-level waste sludge and salt generated at the Savannah River Plant. Waste processing activities covered by the model include decontamination of the salt by a precipitation process in the waste storage tanks, incorporation of the sludge and radionuclides removed from the salt into glass in the Defense Waste Processing Facility (DWPF), and, after interim storage, final disposal of the DWPF glass waste canisters in a Federal geologic repository. Total costs for processing of waste generated to the year 2000 are estimated to be about $2.9 billion (1984 dollars); incremental unit costs for DWPF and repository disposal activities range from $120,000 to $170,000 per canister depending on DWPF processing schedules. In a representative evaluation of process alternatives, the model is used to demonstrate cost effectiveness of adjustments in the frit content of the waste glass to reduce impacts of wastes generated by the salt decontamination operations. (Author's abstract)
W87-07012

LONG-TERM EFFECTIVENESS OF CAPPING IN ISOLATING DUTCH KILLS SEDIMENT FROM BIOTA AND THE OVERLYING WATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5G.
W87-07017

DEVELOPMENT OF A MODIFIED ELUTRIATE TEST FOR ESTIMATING THE QUALITY OF EFFLUENT FROM CONFINED DREDGED MATERIAL DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-07028

INTERPRETATION OF THE CONVERGENT-FLOW TRACER TESTS CONDUCTED IN THE CULEBRA DOLOMITE AT THE H-3 AND H-4 HYDROPADS AT THE WASTE ISOLATION PILOT PLANT (WIPP) SITE,
INTERA Technologies, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W87-07029

SURVEY OF EQUIPMENT AND CONSTRUCTION TECHNIQUES FOR CAPPING DREDGED MATERIAL,
Sand Hen Corp., Wilmington, NC.
W. H. Sanderson, and A. L. McKnight.
Available from the National Technical Information Service, Springfield, VA 22161. Army Engineers Waterways Experiment Station, Vicksburg, MS, Miscellaneous Paper D-86-6, October 1986. Final Report. 52 p, 18 fig, 21 ref. Department of the Army Contract DACW39-83-M-2626.

Descriptors: *Waste disposal, *Capping, *Dredging, Equipment, Long Island Sound, Surveys, Construction methods, Sediments.

The objective of this report is to synthesize, to an extent, the dredging, transporting, disposal, capping, and monitoring efforts that have been performed and to supplement the information by relating it to practical engineering and plant-operating concepts. Experimentation with the capping procedure has revealed significant facts concerning the behavior of such disposed material in the Long Island Sound and at the New York Mud Dump Site. At present, the limiting physical conditions that would permit a satisfactory capping operation are known only in approximate terms. No specific criteria have been developed for the capping procedure. The equipment employed in work done to date was conventional and was operated in conventional fashion. There is equipment available now that if properly employed would improve the quality of each phase of the disposal/capping process. Such currently available equipment includes precision electronic positioning systems for navigation and surveillance, split hull hopper dredges, and self-propelled hopper barges for transporting and disposal. Some innovations that should be required where applicable are closed grab buckets for wire line dredges and ladder pumps for increased slurry density in hydraulic dredging. Such equipment, if specified, will immediately improve the procedure. Equipment that could be constructed with existing technology includes ladder bucket dredges that produce high density material with less turbidity production. Carefully controlled spreading techniques were used. Hydraulic and mechanical systems are explored in this regard. The concept of capping contaminated material deposited in open water has the potential for mitigating some serious disposal conditions. It will not work universally, and much needs to be learned about the behavior of underwater disposal sites before the potential can be fully exploited. Work to date highlights the importance of making accurate predictions concerning soil engineering, coastal and ocean engineering, as well as equipment performance characteristics. (Author's abstract)
W87-07033

COEFFICIENT OF COMMUNITY LOSS TO ASSESS DETRIMENTAL CHANGE IN AQUATIC COMMUNITIES,
Maine Dept. of Environmental Protection, Augusta.
D. L. Courtemanch, and S. P. Davies.
Water Research WATRAG, Vol. 21, No. 2, p 217-222, February 1987. 4 fig, 2 tab, 15 ref.

Descriptors: *Waste disposal, *Bioindicators, *Wastewater disposal, *Taxonomy, *Population dynamics, *Water pollution effects, Macroinvertebrates, Equations, Species composition, Environmental effects.

Many techniques used to evaluate biological community data for effects of wastewater discharge do not discriminate between change and harmful change. A coefficient using the ratio of numbers of taxa lost between an unaffected reference community and a pollution affected community, to the total number of taxa found in the affected community, provides a better evaluation of detrimental change. The value of the coefficient is determined by both the observed change in community richness as well as change in taxonomic similarity. The coefficient produces values from zero indicating no harmful change to infinity where there is complete loss of a community. Macroinvertebrate data suggests that values exceeding 0.8 are indicative of excessively harmful change in those communities. (Author's abstract)
W87-07058

LONG-TERM EFFECTS OF METAL-RICH SEWAGE SLUDGE APPLICATION ON SOIL POPULATIONS OF BRADYRHIZOBIUM JAPONICUM,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W87-07077

IMPROVING HEAVY METAL SLUDGE DEWATERING CHARACTERISTICS BY RECYLING PREFORMED SLUDGE SOLIDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-07098

GROUNDWATER CONTAMINATION FROM WASTE MANAGEMENT SITES: THE INTERACTION BETWEEN RISK-BASED ENGINEERING DESIGN AND REGULATORY POLICY: 1. METHODOLOGY,
Hart, Crowser and Associates, Inc., Seattle, WA.
J. Massmann, and R. A. Freeze.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 351-367, February 1987. 4 fig, 3 tab, 52 ref, 2 append.

Descriptors: *Groundwater pollution, *Waste management, *Water pollution, *Groundwater, *Cost-benefit analysis, Design criteria, Public policy, Policy making, Economic aspects, Legal aspects, Cost analysis, Costs, Risks, Benefits, Construction costs, Operating costs, Path of pollutants, Simulation, Monte Carlo method, Mathematical studies, Mathematical equations, Land disposal, Landfills.

A risk-cost-benefit analysis for waste management facilities is described that explicitly recognizes the adversarial relationship that exists in a regulated economy between the owner/operator of a waste management facility and the government regulatory agency under whose terms the facility must be licensed. The risk-cost-benefit is set up from the perspective of the owner/operator. It can be used directly by the owner/operator to assess alternative design strategies. It can also be used by the regulatory agency to assess alternative regulatory policy, but only in an indirect manner, by examining the response of an owner/operator to the stimuli of various policies. The objective function is couched in terms of a discounted stream of benefits, costs, and risks over an engineering time horizon. Benefits are in the form of revenues for serv-

ices provided; costs are those of construction and operation of the facility. Risk is defined as the cost associated with the probability of failure, with failure defined as the occurrence of groundwater contamination. Failure requires a breach of the containment structure and contaminant migration through the hydrogeological environment to a compliance surface. The probability of failure can be estimated on the basis of reliability theory for the breach of containment and with a Monte-Carlo finite-element simulation for the advective contaminant transport. In the hydrogeological environment the hydraulic conductivity values are defined stochastically. The probability of failure is reduced by the presence of a monitoring network. While the framework is general, the analysis is specifically suited to a landfill in which the primary design feature is one or more synthetic liners in parallel. Contamination is brought about by the release of a single, inorganic nonradioactive species into a saturated, high-permeability, advective, steady state horizontal flow system. It is possible to carry out sensitivity analysis for a wide variety of influences on the system. (See also W87-07116) (Author's abstract)
W87-07115

GROUNDWATER CONTAMINATION FROM WASTE MANAGEMENT SITES: THE INTERACTION BETWEEN RISK-BASED ENGINEERING DESIGN AND REGULATORY POLICY: 2. RESULTS,
Hart, Crowser and Associates, Inc., Seattle, WA.
J. Massmann, and R. A. Freeze.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 368-380, February 1987. 5 fig, 13 tab, 22 ref.

Descriptors: *Groundwater pollution, *Waste management, *Water pollution, *Groundwater, *Cost-benefit analysis, Design criteria, Public policy, Policy making, Economic aspects, Legal aspects, Cost analysis, Costs, Benefits, Mathematical studies, Mathematical equations, Land disposal, Monitoring, Sensitivity analysis, Conductivity, Risk, Design standards.

The risk-cost-benefit analysis developed previously is applied to (1) an assessment of the relative worth of containment-construction activities, site-exploration activities, and monitoring activities as components of a design strategy for the owner/operator of a waste management facility; (2) an assessment of alternative policy options available to a regulatory agency; and (3) a case history. Sensitivity analyses designed to address the first issue show that the allocation of resources by the owner/operator is sensitive to the stochastic parameters used to describe the hydraulic conductivity field at a site. For the cases analyzed, the installation of a dense monitoring network is of less value to the owner/operator than a more conservative containment design. Sensitivity analyses designed to address the second issue suggest that from a regulatory perspective, design standards should be more effective than performance standards in reducing risk, and design specifications on the containment structure should be more effective than those on the monitoring network. Performance bonds posted before construction have a greater potential to influence design than prospective penalties to be imposed at the time of failure. Siting on low-conductivity deposits is a more effective method of risk reduction than any form of regulatory influence. Results of the case history indicate that the methodology can be applied successfully at field sites. (See also W87-07115) (Author's abstract)
W87-07116

EXTRACTABILITY AND BIOAVAILABILITY OF ZINC, NICKEL, CADMIUM, AND COPPER IN THREE DANISH SOILS SAMPLED 5 YEARS AFTER APPLICATION OF SEWAGE SLUDGE,
Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 5B.
W87-07142

LAND APPLICATION SYSTEMS SHOW VERSATILITY,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
D. Freedman.
Biocycle BCYCDK, Vol. 28, No. 2, p 24-26, February 1987. 10 ref.

Descriptors: *Land disposal, *Spray irrigation, *Waste disposal, *Impaired water use, *Economic aspects, *Recycling, Wastewater treatment, Sludge, Georgia, Local governments.

More than 100 spray irrigation projects reuse wastewater at municipal and industrial sites in the state of Georgia, while 40 facilities, including some private companies, land-apply sludge. Practice of these applications goes back to the early 1970's in Georgia. Six facilities currently in operation are described, including examples of both spray irrigation and sludge application. (Airone-PTT)
W87-07165

MATERIAL BALANCE OF THE COMPOSTING PROCESS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5D.
W87-07166

MATURITY ASSESSMENT IN FOOD WASTE COMPOST,
Amsterdam Univ. (Netherlands).
K. A. Mooijman, and H. W. A. Lustenhouwer.
Biocycle BCYCDK, Vol. 28, No. 2, p 34-35, February 1987. 2 tab, 7 ref.

Descriptors: *Composting, *Optimization, *Organic wastes, Starch, Organic carbon, Moisture, Recycling, Temperature, Economic aspects.

In the production of compost, 'shortest time' is an important factor for economic reasons. If the total time of composting is too short, however, the compost is not mature and its use may be undesirable. A universal method for 'maturity assessment' has not yet been developed. The authors examine the time development of both physical (temperature and moisture) and chemical (TOC and starch content) parameters to identify a useful indicator of maturity. The decrease of the chemical parameters is very swift: after about one week of composting, the end values are already approximated. Only the physical parameters (temperature and moisture content) give an indication of compost maturity. Compost of VFG (vegetables, fruit, gardens) will be mature if the moisture content of the composting material remains about 30% for at least two weeks and the temperature in the compost piles equals that of the surroundings, under optimal forced aeration conditions. (Airone-PTT)
W87-07167

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART II-BIOLOGICAL PROCESS CONTROL,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5G.
W87-07169

SEWAGE SLUDGE AS A PHOSPHORUS AMENDMENT FOR SESQUIOXIC SOILS,
Soil and Irrigation Research Inst., Pretoria (South Africa).
M. J. McLaughlin, and L. Champion.
Soil Science SOSCAK, Vol. 143, No. 2, p 113-119, February 1987. 3 fig, 4 tab, 26 ref.

Descriptors: *Sludge disposal, *Land disposal, *Sesquioxic soil, *Phosphorus, Nutrients, Fertilizers, Ryegrass, Soil types, Accumulation, Crop yield, Tissue analysis.

The effectiveness of sludge P in comparison with inorganic P, as a fertilizer for P-deficient sesquioxic soils. Municipal sewage sludge and monocalcium phosphate (MCP) were applied to two soils-Griffin clay (Typic Haplorthox) and Clovelly sandy clay loam (Tropeptic Haplorthox)-at rates equivalent to 200, 500, and 1,000 kg/ha P. Italian ryegrass (Lolium multiflorum) was grown in the soils using a split pot technique, and tops were harvested at 14, 35, 63, 97, 125, 153, 181, and 209 d after commencement of rootsoil contact. Yield and concentration of P, N, Ca, Mg, K, and Na in the plant tissue were determined. Both soils exhibited large responses to applied P, with P uptake from sludge treatments being significantly greater ($P < 0.05$) than MCP treatments in the Griffin soil, and significantly lower than MCP treatments in the Clovelly soil. Rates of P uptake declined rapidly with time in MCP-treated soils, and in sludge-treated soils rates of P uptake increased or declined only slowly. The relative efficiency of sludge P compared with MCP increased from 44 to 90% and 64 to over 100% with time in the Clovelly and Griffin soils, respectively. (Author's abstract)
W87-07223

METAL MOVEMENT IN SLUDGE-AMENDED SOILS: A NINE-YEAR STUDY,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W87-07225

POPULATION DYNAMICS AND SECONDARY PRODUCTION IN AN ESTUARINE POPULATION OF NEPHTYS HOMBERGII (POLYCHAETA: NEPHTYIDAE),
Southampton Univ. (England). Dept. of Oceanography.
J. A. Oyenekan.
Marine Biology MBIOAJ, Vol. 93, No. 2, p 217-223, November 1986. 8 fig, 1 tab, 25 ref.

Descriptors: *Limnology, *Population dynamics, *Estuaries, *Polychaetes, *Secondary production, Worms, England, Silt, Copper, Sediments, Reproduction, Biomass, Production.

From July 1978 to March 1980, a study was made on the distribution, population dynamics and secondary production of Nephtys hombergii Audouin et Edw. occurring in the sublittoral industrialized region of Southampton Water in south England. The distribution of the worm was related to the silt content and copper level of the sediment, the greatest densities of N. hombergii being found in sediment containing 60 to 100% silt. Breeding occurred at a low level throughout the year, with a maximum in July to September and November to January in the second year of growth. Spawning occurred when the oocytes measured 200 micron in diameter, and unshed gametes were resorbed. Annual production varied between 0.092 and 4.32 g C/sq m/y (ash-free dry weight) and amounted to 1.9-39.4% of the total macrofaunal production at the sampling stations. The production:biomass (P:B) ratio of the species varied between 1.6 and 2.9. (Author's abstract)
W87-07226

USE OF A SENSITIVE INDICATOR SPECIES IN THE ASSESSMENT OF BIOLOGICAL EFFECTS OF SEWAGE DISPOSAL IN FJORDS NEAR BERGEN, NORWAY,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5C.
W87-07229

MANAGEMENT OF TOXIC AND HAZARDOUS WASTES.
Lewis Publishers, Inc., Chelsea, Michigan. 1985. 418 p. Edited by Harasiddhiprasad G. Bhatt, Robert M. Sykes, and Thomas L. Sweeney.

Descriptors: *Waste management, *Hazardous wastes, *Toxicity, *Water pollution effects, *Waste disposal, Conferences, Groundwater pollution, Cleanup operations, Water pollution treatment, Land disposal, Recycling.

This book is a product of the Third Ohio Environmental Engineering Conference held in Columbus, Ohio in 1983. Chapters presented in this books

have been updated to reflect present conditions. This book, therefore, is a current reference work on the management of toxic and hazardous wastes. Increasing attention is now being focused on the problem of groundwater pollution in this country. The demand for cleaning of hazardous waste disposal sites has also grown stronger since the passage of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (commonly known as Superfund). In sections on the impact of groundwater and disposal site cleanup, this book presents twelve chapters on these important aspects of hazardous waste management. Attention has also been focused on waste treatment and recycle, risk assessment, public participation and land disposal. The section on legal considerations provides valuable pointers on the precautions to be taken and pitfalls to be avoided to minimize legal liabilities. (See also W87-07244 thru W87-07278) (Lantz-PTT)
W87-07243

IMPLEMENTATION OF RCRA AND SUPERFUND BY THE U.S. EPA - THE STATE'S PERSPECTIVE,
Vermont State Agency of Environmental Conservation, Montpelier.
For primary bibliographic entry see Field 6E.
W87-07244

CONFLICTS AND HAZARDOUS WASTE MANAGEMENT - THE ENVIRONMENTALIST'S VIEWPOINT,
Cleveland State Univ., OH.
W. B. Clapham.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 9-17, 8 ref.

Descriptors: *Hazardous wastes, *Waste disposal, *Public opinion, *Site selection, *Waste management, Environmental effects, Disposal sites, Public policy.

All of the dimensions of hazardous waste management come together with facility siting. Facility siting brings government, the private sector, and the public together in an emotion-charged arena where painful decisions are made. All parties enter the fray loaded for bear, and the battle generally ends when one protagonist runs for cover. Hazardous waste management is an area in which the basic interests of industrial generators and environmentalists overlap almost precisely. Their reasons are very different: industry needs functioning 'kidneys' that will let it produce its product at the lowest possible cost, so that it can gain market share and increase profit. Environmentalists need effectively functioning hazardous waste management facilities to minimize the release of hazardous materials into the environment where they can affect public health and ecosystems stability. Regardless of their differences, the similarity of basic interest makes them allies (albeit of convenience) in the matter of hazardous waste management, not adversaries. Despite this, the most common attitude among the public is the very negative syndrome commonly known as NIMBY (not in my back yard). It has been a remarkably effective tool for organizing successful grass roots resistance to hazardous waste management facilities. A community will recognize when an entrepreneur is making a bona fide effort to treat it fairly. The system will work where the community trusts the operator and the key regulatory agencies. If this statement seems too sweeping, perhaps it is better to say that the system will not work where the community distrusts the operator and the regulatory agency. For a developer with a plan for a hazardous waste management facility, there are five crucial steps to establish a dialogue with a community and to convince it that it can and will be a host: (1) go public with the plant; (2) accept the community as a peer; (3) make a commitment to negotiate with the community in good faith; (4) work toward a consensus among all parties; and (5) the consensus position should be the basis of permit application, which will include mechanisms to insure the continuity of the consensus built. (See also W87-07243) (Lantz-PTT)
W87-07245

PUBLIC PARTICIPATION IN OHIO EPA'S SOLID AND HAZARDOUS WASTE PROGRAM,
M. L. Greenberg.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 19-23.

Descriptors: *Public participation, *Ohio, *Waste disposal, Waste management, Hazardous wastes, Public opinion, Legislation.

Proper management of solid and hazardous waste materials, facilities and disposal sites is a major concern for industry, government and the private citizen. The nature and potential impact of solid and hazardous waste on the environment and the numerous complex issues surrounding each Agency decision necessitates the cooperation of elected officials, other government agencies, industry, special interest groups and individual citizens. In order to provide a forum and opportunity for public involvement, Congress and U.S. EPA wrote laws and developed policies for public participation. There are many opportunities for public participation in the programs of the Division of Solid and Hazardous Waste Management in Ohio EPA. Some of these are formal, required by federal or states laws and regulations and some, are informal, developed by the Agency and the Division in an effort to work with the many sectors of statewide community, to make programs more responsive to varied concerns and to develop mutual trust between the Division of Solid and Hazardous Waste Management and the people of Ohio. (See also W87-07243) (Lantz-PTT)
W87-07246

HEALTH AND SAFETY CONSIDERATIONS FOR HAZARDOUS WASTE WORKERS,
Brigham Young Univ., Provo, UT.
For primary bibliographic entry see Field 9B.
W87-07247

HAZARDOUS WASTE MANAGEMENT - AN INDUSTRY PERSPECTIVE,
Republic Steel Corp., Cleveland, OH.
W. L. West.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 36-39.

Descriptors: *Waste disposal, *Waste management, *Legislation, Regulations, Management planning, Environmental effects, Safety.

In late 1976, the Congress of the United States passed the Resource Conservation and Recovery Act of 1976 with the express purpose of regulating the treatment, storage, transportation, and disposal of hazardous wastes which have adverse effects on health and the environment. The Act also promoted the demonstration, construction and application of solid waste management, resource recovery, and resource conservation systems which preserved and enhanced the quality of air, water and land resources. Over eight years have elapsed since Congress passed RCRA and established these noble objectives. Changing attitudes have been discerned recently in this respect, as regulators have begun the process of rationally informing the public in the positive aspects of responsible hazardous waste management. Included in this new attitude is the agency's recent promotion of the recycle and reuse concepts for hazardous wastes. Hazardous wastes that present health or environmental risks must be properly identified. Such waste should be treated, contained, or disposed in permitted facilities as expeditiously as the permits can be issued. (See also W87-07243) (Lantz-PTT)
W87-07248

PARTNERSHIP APPROACH TO HAZARDOUS WASTE FACILITY SITING,
Ohio Environmental Council, Inc., Columbus.
S. H. Sedam.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 41-44.

Descriptors: *Waste disposal, *Site selection, *Waste management, Hazardous wastes, Case studies, Public participation.

Before a facility is built or expanded, it must first run the course of a facility siting process. The process is supposed to operate just as it appears on an agency's facility siting flow chart, the one with the neat boxes and smooth, flowing lines. A facility siting process is largely determined at the state level by laws, regulations, and guidance documents which vary from state to state. There are nearly as many approaches to citizen involvement in these processes as there are siting procedures. In examining the siting processes around the country, it is obvious that no one has the answer yet. Community involvement and case histories are presented to discuss this problem. In summary, the peer or partnership approach to facility siting is paramount to successful siting. A company cannot assume it knows all of the community's concerns and at the same time the need for additional facilities cannot be denied. Business and industry need to have expanded hazardous waste treatment, storage, and disposal opportunities available. They also need to take a more open view toward the siting process than has been the norm to date. Developing a partnership with the host community makes just plain good business sense. (See also W87-07243) (Lantz-PTT)
W87-07249

SOLID WASTE FACILITY SITING - COMMUNITY ASPECTS AND INCENTIVES,
Battelle Columbus Labs., OH.
H. E. Smail.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 45-63, 1 tab, 15 ref.

Descriptors: *Public opinion, *Solid waste disposal, *Site selection, *Waste management, Disposal sites, Regulations, Environmental effects.

As local community officials and citizens begin to undertake and evaluate a proposed solid waste management and facility siting program, the need quickly arises for information to understand the complexities of solid waste management programs (e.g., siting methodologies, regulations, technologies, etc.) so that informed public decisions can be made regarding specific questions about procedures, risks, impacts, costs and other aspects of the proposed program. Accordingly, the generic overview of nontechnical socioeconomic and political/regulatory aspects of solid waste management programs presented in this chapter can assist public officials and citizens at the outset in formulating an effective and workable approach for evaluating and solving their waste management concerns. (See also W87-07243) (Lantz-PTT)
W87-07250

STATISTICAL EVALUATION OF HYDRAULIC CONDUCTIVITY DATA FOR WASTE DISPOSAL SITES,
Neyer, Tiseo and Hindo, Ltd.
For primary bibliographic entry see Field 2G.
W87-07252

NEW YORK STATE INDUSTRIAL MATERIALS RECYCLING PROGRAM,
New York State Environmental Facilities Corp., Albany.
For primary bibliographic entry see Field 6E.
W87-07259

ROLE OF A WASTE EXCHANGE IN INDUSTRIAL WASTE MANAGEMENT - DEVELOPMENT OF THE NORTHEAST INDUSTRIAL WASTE EXCHANGE,
Northeast Industrial Waste Exchange.
W. Banning.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 209-214.

Descriptors: *Waste exchange, *Waste management, *Industrial wastes, *Waste disposal, *Northeast Industrial Waste Exchange, Economic aspects, Recycling, Regulations.

Industrial and hazardous waste management practices in this country are in the midst of a major transition. This slowly evolving transition may be characterized as a change from the relatively easy and inexpensive land disposal practices of the past to the growing emphasis on waste reduction, recycling and resource recovery. This major change in the concept of waste management is occurring primarily for two basic economic reasons: the first is the dramatic increase in waste disposal costs brought about by stricter waste disposal regulations nationwide and the growing scarcity of suitable waste disposal sites, and the second factor is the rising cost of energy and raw materials which is making it much more economically attractive than in the past for manufacturing companies to investigate recycling, resource recovery, and raw material substitution opportunities. Well-established scrap markets exist for the purchase, collection, and processing of many industrial by-products. However, there is a wide variety of other industrial wastes, especially hazardous wastes, for which no readily identifiable market exists. In an era where changing economies and technology are shifting in fine definitional lines between a 'waste' and a 'scrap', the need has developed for a formal, institutionalized transfer agent to help identify and bring together generators of waste with reuse value and those recyclers who can realize its potential value. Discussed is the development of the Northeast Industrial Waste Exchange, the initial results of the exchange, impediments to the success of the exchange, and regulations of the exchange. (See also W87-07243) (Lantz-PTT)
W87-07260

EUROPEAN NETWORK OF WASTE EXCHANGES,
Ohio State Environmental Protection Agency, Columbus.
T. E. Crepeau, and P. R. Beltz.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 223-226.

Descriptors: *Waste disposal, *Waste exchange, *Austria, *Switzerland, *Recycling, *Italy, *France, Waste management, *Germany, Recycling, Economic aspects, Costs analysis, Hazardous wastes.

Throughout most of western Europe there exists an efficiently operated network of waste exchanges which serve as an important element in promoting effective waste management in each country as well as among the countries participating in the system. A waste exchange can be defined simply as a clearinghouse of coordinating operation between buyers and sellers of industrial production residues which can be used again in the production cycle. The operation of these waste exchanges in Europe is viewed as a valid form of recycling; in addition they serve a number of other purposes as well. Included as secondary benefits are a potential savings of disposal costs, a saving of raw materials and above all a lessening of the amount of production materials which otherwise might end up as waste products requiring incineration or land disposal particularly for materials considered under law to be hazardous. The first exchange in Europe began operations in the Hague, Netherlands in 1969 under the sponsorship of the Dutch Chemical Association. Throughout the 1970's many other waste exchanges appeared on the scene some of which were initiated by trade associations, technological or research institutes of chambers of commerce. The latter group, namely the chambers of commerce, serve as the most common operating umbrella in Europe as far as the number of operating waste exchanges is concerned. The national chambers in conjunction with local and regional chambers of commerce participate in exchange operations in Austria, France, Germany, Italy and Switzerland. (See also W87-07243) (Lantz-PTT)
W87-07262

HAZARDOUS WASTE LAND DISPOSAL REGULATIONS - AN ENVIRONMENTALIST PERSPECTIVE,
Environmental Defense Fund, Washington, DC.
L. E. Greer, and D. J. Lennett.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 227-236, 18 ref.

Descriptors: *Hazardous wastes, *Land disposal, *Waste disposal, *Regulations, Environmental effects, Monitoring, Water pollution control, Landfills, Economic aspects.

There are four major problems with the hazardous waste land disposal regulations: lack of regulation for air emission monitoring and control, lack of requirement to retrofit existing facilities with liners, lack of requirements to show financial capability to perform corrective action, and, finally, lack of requirement to clean up contamination which has migrated beyond the facility property boundary. These are discussed in detail in this chapter. As a preface to this discussion, however, it is important to emphasize that no matter how strict the regulations, landfills will remain the least desirable method of disposing of hazardous waste. Steps therefore must be taken to shift wastes out of landfills as a priority for sound hazardous waste disposal. After land disposal has been fully minimized, there will still be a need for stringent and effective regulations to cover existing hazardous waste landfills and new landfills whose necessity has been adequately demonstrated. The July 26 regulations which are discussed here fall short of providing this strict and adequate protection. (See also W87-07243) (Lantz-PTT)
W87-07263

INFLUENCE OF HAZARDOUS AND TOXIC WASTES ON THE ENGINEERING BEHAVIOR OF SOILS,
Woodward-Clyde Consultants.
For primary bibliographic entry see Field 5C.
W87-07264

SITE SELECTION AND DESIGN CONSIDERATIONS FOR HAZARDOUS WASTE LAND DISPOSAL FACILITIES,
Burns and McDonnell, Kansas City, MO.
P. A. Hustad, and J. A. Ruf.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 265-281, 3 ref.

Descriptors: *Waste disposal, *Disposal sites, *Site selection, *Hazardous wastes, *Management planning, Land disposal, Subsurface drainage, Subsurface mapping, Geohydrology, Cost analysis.

The intent of this chapter is to outline the phases required for the siting, design, and construction of hazardous waste landfill facilities. There are many factors which should be evaluated prior to the selection of a site for a disposal facility. Examples of some of the factors which play a role in site selection are (1) a demonstrated need for such a facility, (2) nearness to waste generators, (3) the size of the required facility, (4) availability of large parcels of land, (5) nearness to neighbors, (6) potential for obtaining regulatory approval, (7) zoning, and (8) the client's overall company growth plan. These three phases are: (1) to determine whether the potential site warrants additional study and investigation in Phase 2; (2) to develop and implement a detailed plan, keeping cost in mind; and (3) to answer questions about subsurface features through additional laboratory and field investigations. The important role of the geologist, geotechnical and environmental engineer is self-evident from the nature of the facilities, which involve the handling of large quantities of earth on a daily basis. By comparison to other construction projects, hazardous waste landfill developments are most likened to the construction of earth dams, as both require attention to detail from beginning to end. While most construction projects require performance to be satisfactory over the economic life of the project, which often is a 30- to possibly 100-year period, secure landfill facilities are expected to perform properly for hundreds of years. Unfortunately, the systematic disposal of wastes has only developed on a large-scale basis in the last 30 years and long-term performance records are lacking. The monitoring of the long-term performance of these facilities promises to be the most advantageous means of increasing knowledge for future and better landfill designs. (See also W87-07243) (Lantz-PTT)
W87-07265

EPA'S LAND DISPOSAL REGULATIONS - WASTE DISPOSAL INDUSTRY'S PERSPECTIVE,
Environmental Protection Agency, Washington, DC.
R. Rubenstein.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 283-287.

Descriptors: *Land disposal, *Regulations, *Waste disposal, *Industrial waste, Waste management, Hazardous wastes.

The Institute of Chemical Waste Management includes those member firms of the National Solid Wastes Management Association that are active in storage, treatment and disposal of hazardous and other industrial wastes. The member companies are active in all aspects of hazardous waste management. These methods include treatment (e.g., solidification), recovery, incineration, and deep well injection. Like everyone else committed to recovery and treatment, all of the members are dependent on land disposal for management of those wastes that are not economically or technically feasible to treat. Treatment processes themselves often result in residues, often hazardous if to a lesser degree than the original waste itself, that must be disposed of in the land. Even the most committed advocates of treatment rely on land disposal and several treatment oriented companies actually own and operate land disposal facilities as part of their waste management system. The waste service industry is committed to a program of strict environmental regulation for the land disposal of hazardous wastes. The EPA program which is aimed at limiting the amounts of liquids destined for land disposal is right on target and deserves public and congressional support. Although there have been some technical problems with the regulations as written, the association is ready to work with any group or agency to assure that hazardous waste is well managed now and in the future. (See also W87-07243) (Lantz-PTT)
W87-07266

CLEANUP OF A VINYLIDENE CHLORIDE AND PHENOL SPILL,
Williams and Works/Environmental Data Inc.
For primary bibliographic entry see Field 5G.
W87-07268

CASE HISTORY - REMEDIAL INVESTIGATION RE-SOLVE, INC. HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W87-07269

WASTE STABILIZATION BASIN DISCHARGE ELIMINATION AND REMEDIATION - A CASE STUDY,
O'Brien and Gere Engineers, Inc.
W. H. Bouck, A. N. Johnson, and S. J. Fleischacker.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 319-326.

Descriptors: *Waste disposal, *Water pollution control, *Stabilization ponds, *Case studies, Waste treatment, Sediments, Sludge, Environmental effects, Landfills.

An effective source control and waste segregation program was implemented, and a pretreatment facility designed, constructed and is now in oper-

ation. Upon removing the waste stabilization basin from service, a characterization program was conducted which identified the existence of a contaminated sediment/sludge layer resulting from years of sediment deposition due to waste stabilization basin activity. This solids layer was overlain by a contaminated aqueous layer and had to be removed prior to removal of the sediment/sludge layer. Environmentally sound remedial options were identified upon evaluation of those alternatives. The selected approach was the excavation and disposal of these solids in an off-site secure landfill. The site was closed in June 1981, thereby eliminating the waste stabilization basin as a source of environmental contamination. (See also W87-07243) (Lantz-PTT)
W87-07270

SITE SAFETY AND SAMPLING PLANS - THE FIRST STEP IN INVESTIGATING ABANDONED HAZARDOUS WASTE DISPOSAL SITES,
Black and Veatch, Kansas City, MO.
J. W. Edwards, V. M. Reid, and P. B. MacRoberts.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 327-334.

Descriptors: *Waste disposal, *Hazardous wastes, *Sampling, *Path of pollutants, *Safety, Personnel.

The development of comprehensive site-specific safety and sampling plans is a prerequisite to field investigations of abandoned hazardous waste disposal sites. Preparation of safety plans requires consideration of natural hazards, as well as those posed by hazardous waste materials. Emergency plans are needed to ensure an automatic, immediate response by on-site personnel in the event of any of a number of possible accidents. The sites are divided into hot, decontamination, and support areas. Safety equipment, protective clothing, and safety procedures are prescribed for each area. Sampling and monitoring activities performed at hazardous waste disposal sites are potentially dangerous to the people involved, yet are performed because of project objectives. Site sampling plans are developed and employed to ensure that a quality product will result. The safety and sampling plans are designed to protect the field personnel. These plans are only as effective as the people who implement them. Each member of the project team is responsible for the safe achievement of the quality product. (See also W87-07243) (Lantz-PTT)
W87-07271

SOIL INVESTIGATION AT THE RE-SOLVE, INC., HAZARDOUS WASTE SITE,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W87-07273

ENVIRONMENTAL RISK ASSESSMENT,
Risk Science International, Washington, DC.
For primary bibliographic entry see Field 5C.
W87-07274

RADIOACTIVE WASTE DISPOSAL BY UKAEA ESTABLISHMENTS DURING 1984 AND ASSOCIATED ENVIRONMENTAL MONITORING RESULTS,
UKAEA National Centre of Systems Reliability, Culcheth (England).
G. C. Meggitt, and A. C. Graham.
Safety and Reliability Directorate Report No. SRD R388, April 1986. 21 p, 14 tab, append.

Descriptors: *Waste disposal, *Radioactive waste disposal, *Radioactive wastes, *England, Safety, Regulations, Environmental effects, Monitoring, Water pollution effects, Atomic Energy Research Establishment, Dounreay Nuclear Power Development Establishment, Atomic Energy Establishment.

This report gives details of the amounts of solid and liquid radioactive waste disposed of by the principal Establishments of the UKAEA (Atomic Energy Research Establishment (AERE), Harwell; Dounreay Nuclear Power Development Establishment (DNE); and, Atomic Energy Establishment (AEE), Winfrith) during 1984. Waste arising at the UKAEA Nuclear Power Development Laboratories at Windscale and Springfields, which are both situated on British Nuclear Fuels plc (BNF plc) sites, is disposed of by BNF plc and included in their authorizations. Discharges to the atmosphere of airborne radioactive waste are also included in the report. A summary of the results of the environmental monitoring programs carried out in connection with the radioactive waste discharges is given. To facilitate an appreciation of the standard of safety achieved, the discharges are, where appropriate, shown as a percentage of those authorizations, but the results and estimates of discharges from stacks are compared with Derived Limits (DLs) (i.e., a limit derived from the dose limits recommended by the International Commission on Radiological Protection (ICRP), in such a way that compliance with it implies virtual certainty of compliance with the relevant dose limits). Environmental monitoring results are also compared with appropriate DLs recommended by the NRPB. The principles underlying the control of the discharge of radioactive waste to the environment are summarized. (Lantz-PTT)
W87-07344

SLUDGE MANAGEMENT AND DISPOSAL FOR THE PRACTICING ENGINEER,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W87-07387

ECONOMIC IMPACT OF PROPOSED REGULATION R81-25: PROHIBITION OF CHLORINATED SOLVENTS IN SANITARY LANDFILLS.
Dames and Moore, Park Ridge, IL.
For primary bibliographic entry see Field 5G.
W87-07389

WASTES IN THE OCEAN, VOLUME 1: INDUSTRIAL AND SEWAGE WASTES IN THE OCEAN.
State Univ. of New York at Stony Brook.
John Wiley and Sons, New York, New York. 1983. 431 p. Edited by Iver W. Duedall, Bostwick H. Ketchum, P. Kilho Park, and Dana R. Kester.

Descriptors: *Waste disposal, *Ocean dumping, *Water pollution effects, Regulations, Environmental effects, Sediments, Biodegradation, Wastewater disposal, Industrial wastes.

Every year millions of metric tons of industrial wastes and sewage sludges are dumped into the ocean. Scientific research and public debate about the behavior, fate, and effects of these wastes in the sea have increased greatly since 1970. On the global scale, ocean dumping of wastes will probably increase with time. Future dumping will be controlled more rigorously by national laws and international conventions. Application of these laws and conventions will require the understanding, which can be attained through scientific research of wastes in the ocean. Here, the authors provide information on global ocean dumping, the role of U.S. Federal agencies in ocean dumping, toxic effects of pharmaceutical and other industrial wastes, ocean dumping at the U.S. Mid-Atlantic dumpsites, the role of marine amoebae in sediment, and physical and chemical properties of stabilized coal wastes. The ocean dumping of coal wastes may become an important disposal alternative for populated coastal cities where land is scarce. Scientific strategy on industrial and sewage wastes disposal in the ocean is the main topic of the concluding chapter. Although this book is not intended to provide a systematic presentation or treatise on all the scientific aspects of ocean dumping, it does reflect the strong and continuing interest in both the theoretical and descriptive studies on the dumping of industrial and sewage wastes. It provides a better understanding of the problems related to the behavior and the effects of these wastes in the sea. (See also W87-07397 thru W87-07416) (Lantz-PTT)
W87-07396

GLOBAL INPUTS, CHARACTERISTICS, AND FATES OF OCEAN-DUMPED INDUSTRIAL AND SEWAGE WASTES: AN OVERVIEW,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
I. W. Duedall, B. H. Ketchum, P. K. Park, and D. R. Kester.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p. 3-45, 14 fig, 4 tab, 62 ref.

Descriptors: *Fate of pollutants, *Waste disposal, *Ocean dumping, *Path of pollutants, Regulations, Industrial wastes, Wastewater disposal, Sludge, Sedimentation, Wastewater treatment, Biodegradation.

During the 1976-1979 period, the Inter-Governmental Maritime Consultative Organization (IMCO) had been notified of over 2000 permits which were issued mainly for the disposal of dredged material, industrial wastes, and sewage sludge into the ocean. For these wastes, total annual tonnages ranged from 35,000,000 to 231,000,000 metric tons for 1976 and 1978, respectively. Estimated tonnages of industrial wastes ranged from 10,000,000 to 18,000,000 t/yr in 1979, with the United States, France, and the United Kingdom leading all other countries. Annual tonnages of sewage sludge, essentially all from the United States, United Kingdom, and Federal Republic of Germany during the 1976 through 1979 period remained nearly constant at about 16,000,000 t/yr. Physical and chemical properties of industrial and sewage wastes are characterized. Abundances of toxic metallic elements in these wastes varied by order of magnitude when compared on an element-to-element basis. Fly ash and sewage sludge have the highest concentrations of elements of environmental concern. The distribution and fate of an ocean-dumped waste in the sea are complicated, depending on: (1) the physical processes of dispersion, advection, and sedimentation; (2) chemical processes such as volatilization, neutralization, precipitation, flocculation, adsorption, desorption, dissolution, oxidation, and reduction; and (3) biological processes involving response of marine organisms to waste materials, incorporation of these materials within the organism, and modification of waste substances by organisms. (See also W87-07396) (Author's abstract)
W87-07397

WHO IS DOING WHAT IN MARINE DUMPING,
Geological Survey, Woods Hole, MA.
F. T. Manheim.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 47-65, 4 fig, 7 tab, 31 ref.

Descriptors: *Waste disposal, *Ocean dumping, *Economic aspects, Regulations, Waste management, Dredging, Wastewater disposal, Industrial wastes, Construction wastes, Research priorities, Grants.

In 1978, major categories of United States waste products being discharged to the oceans by vessels were: dredged material, 65 million tons (metric); solid sewage waste, 5.0 million tons; and industrial and construction wastes, 2.4 million tons. The amount of treated (liquid) sewage waste discharged to the ocean and estuaries from U.S. coastal communities has been estimated at somewhat less than 20 million tons/day. The principal Federal agencies engaged in in-house or contracted research on waste disposal in the sea are (in order of allocation of funds) the National Oceanic and Atmospheric Administration, the Environmental Protection Agency, and the Department of Energy. The outlays by the Departments of Defense and Interior, the National Science Foundation, and other agencies are smaller. Of the total estimated Federal budget of $186 million for pollution-related work in 1980, some $30 million was

allotted for research on marine waste disposal categories. A very rough estimate of $100 million is spent annually by industry for the disposal of 2.2 million tons of industrial waste. Costs for the disposal of dredged material mostly by the U.S. Army Corps of Engineers may be on the order of $75 million. The operation of large sectors of industry, commerce and coastal urban communities is still dependent on waste material handling or disposal in the marine environment, in spite of the Marine Protection, Research, and Sanctuaries Act of 1972 (Public Law 92-532). Innovation in disposing of wastes in the coastal area is needed. (See also W87-07396) (Author's abstract)
W87-07398

SIMPLE MODELS OF WASTE DISPOSAL IN A GYRE CIRCULATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology and Physical Oceanography.
G. R. Flierl.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 69-85, 7 fig, 4 ref. NOAA Grant NA 80 AA-D-00057.

Descriptors: *Ocean dumping, *Water pollution effects, *Waste disposal, *Gyre circulation, *Model studies, *Path of pollutants, Environmental effects, Flow pattern, Marine organisms, Flow rates, Mathematical analysis, Biodegradation, Ecosystems.

Several simple models show the distribution of waste and impact of waste dumping in a region where there is a circulating flow. First, the distribution in the absence of biological feedback effects is considered and the dependence on the flow rate, the scale of the gyre, the decay time of the waste, and the dumping rate are described. Second, a biological model, with a growth rate dependent on the density of organisms and a death rate varying with the waste concentration, is used to examine what the impact on organisms within the gyre might be. Finally, various situations with biological feedback, introduced by making the decay rate of the wastes dependent on the level of biological activity, are considered. When the death rate varies nonlinearly with concentration, 'catastrophes' (in the mathematical sense) can occur: the population may suddenly die out with only a small increase in the dumping rate. The models are intended to illustrate possible behaviors when the physics, chemistry, and biology of a polluted ecosystem are all considered together; no attempts are made to apply these models in detail. Model calculations suggest that the most important quantities to measure are the decay time of the waste and its dependence on the population parameters, the rate at which mortality increases given a change in waste concentration, and the circulation time for the gyre. In addition, the rate of loss of material from the gyre and the rate at which fresh populations enter seem also likely to be important information which could be gathered from physical measurements in the field. (See also W87-07396) (Lantz-PTT)
W87-07399

PHYSICAL OCEANOGRAPHY STUDIES RELATED TO WASTE DISPOSAL IN THE SEA,
Copenhagen Univ. (Denmark). Inst. of Physical Oceanography.
G. E. B. Kullenberg.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 87-101, 5 fig, 2 tab, 26 ref.

Descriptors: *Model studies, *Waste disposal, *Ocean dumping, *Oceanography, *Path of pollutants, Physical properties, Mixing, Stratification, Eddies.

Theoretical models of horizontal and vertical mixing of ocean-dumped wastes on small to mesoscales are presented. Observations from ocean dumping and dye tracer experiments are used to test the models and to calculate mixing parameters. These are shown to be highly variable, depending on environmental conditions such as wind, current distribution, and density stratification. The experiments show that the waste material in stably stratified conditions can become distributed in well-defined layers related to the current and density distributions. Such layers can be very persistent. Discussed are some physical oceanography studies of interest to waste disposal problems. These studies primarily concern the understanding and prediction of the physical dispersion in various parts of the water column. Outstanding features in this context are: (1) the generally stable stratification, which usually varies in space and time and which implies relatively weak and intermittent small-scale turbulence and associated mixing. The large-scale motion mainly occurs along isopycnals.; (2) the heterogeneity of the physical, chemical, and biological distribution patterns; fronts have been shown to be very common, and mesoscale eddies of sizes in the range of 10-100 km contain most of the kinetic energy and influence the general circulation; and (3) the energy occurs at a number of frequencies and scales, the fluctuating velocities in the sea are normally larger than the mean, and the motion in the deep sea is driven by wind effects and thermohaline forcing. (See also W87-07396) (Lantz-PTT)
W87-07400

LONG-TERM MIXING PROCESSES IN SLOPEWATER,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 5B.
W87-07401

DISPERSION OF PARTICLES AFTER DISPOSAL OF INDUSTRIAL AND SEWAGE WASTES,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 5B.
W87-07402

ACID-IRON DISPOSAL EXPERIMENTS IN SUMMER AND WINTER AT DEEPWATER DUMPSITE-106,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5B.
W87-07403

AUTOMATED IRON MEASUREMENTS AFTER ACID-IRON WASTE DISPOSAL,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W87-07404

VOLATILE ORGANIC WASTES AT THE PUERTO RICO DUMPSITE,
Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W87-07405

MICROBIAL COMMUNITIES IN SURFACE WATERS AT THE PUERTO RICO DUMPSITE,
Maryland Univ., College Park. Dept. of Microbiology.
F. L. Singleton, J. W. Deming, E. R. Peele, B. Cavari, and B. Gunn.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p. 201-218, 6 fig, 3 tab, 25 ref. NOAA Grant NA 79AA-D-00062, and NSF Grant DEB 77-14646, A02.

Descriptors: *Bacteria, *Waste disposal, *Surface waters, *Ocean dumping, *Water pollution effects, *Microbiological studies, *Puerto Rico, Environmental effects, Vibrio, Aeromonas, Bacterial analysis.

A variety of microbiological parameters were determined for surface waters in and surrounding the Puerto Rico dumpsite which is used for disposal of pharmaceutical wastes. Specific activities of microbial populations were derived from comparisons of activity measurements (uptake of radiolabeled substrates or substrate-responsive cell numbers determined by epifluorescent microscopy) and total cell numbers. Highest values were observed in samples from stations in or near the dumpsite. Similarly, largest numbers of colony-forming bacteria, enumerated on marine agar, were obtained in the vicinity of the dumpsite. Total colony-forming bacteria were enumerated at all stations, with several different culture media, and randomly selected isolates were identified to develop diversity indices for the culturable bacterial community. Bacteria isolated on marine agar were found to be predominantly members of the Vibrio/Aeromonas group, with the more typical marine pseudomonads comprising less than 9% of the community. In the vicinity of the dumpsite, large numbers of Gram-positive bacteria, that is, micrococci, staphylococci, and bacilli, were recovered from water samples plated on marine agar, as well as from those plated on plate count agar, which selects against bacteria requiring sea salts for growth. Results obtained, in particular diversity index measurements and the persistence of culturable, waste-specific organisms at the dumpsite, suggest that alterations in the natural microbial populations of surface waters of the Puerto Rico dumpsite and environs have occurred. (See also W87-07396) (Author's abstract)
W87-07406

PHYTOPLANKTON: COMPARISON OF LABORATORY BIOASSAY AND FIELD MEASUREMENTS,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
For primary bibliographic entry see Field 5C.
W87-07407

COPEPODS AND ICHTHYOPLANKTON: LABORATORY STUDIES OF PHARMACEUTICAL WASTE TOXICITY,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
For primary bibliographic entry see Field 5C.
W87-07408

FISH: RESPONSE TO OCEAN-DUMPED PHARMACEUTICAL WASTES,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
For primary bibliographic entry see Field 5C.
W87-07409

HISTORY OF OCEAN DISPOSAL IN THE MID-ATLANTIC BIGHT,
Environmental Protection Agency, Philadelphia, PA. Environmental Impacts Branch.
W. C. Muir.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 273-291, 5 fig, 7 tab, 30 ref.

Descriptors: *Mid-Atlantic Bight, *Ocean dumping, *History, *Waste disposal, *Maryland, *Delaware, Industrial wastes, Municipal wastes, Regulations, Marine environment.

During the 1960s and 1970s a variety of industrial and municipal wastes were dumped in the ocean on the mid-continental shelf bordering Maryland and Delaware. U.S. Environmental Protection Agency (U.S. EPA) Region III managed four disposal sites in this area between 1972 and 1980. In October 1972 when the MPRSA was enacted, there were four ocean dumpsites in U.S. EPA's Region III. On January 1, 1981, that number had been reduced to zero. During that period over 13,000 metric tons of wastes were dumped at sea from Region III's cities and industries. Although it will be difficult to assess all of the impacts due to dumping, the quantitative loadings for the major pollutants at the dumpsites are available. The major emphasis of Region III's permit program was in the development of alternatives. Each dumper received a thorough evaluation of its entire facility in the determination of the need for dumping. Thus, Sun Oil Company had been dumping since 1966; within six months of its first permit

in 1973, Sun Oil Company had developed an abatement plan involving the modification of existing equipment. The technology was already available to recover oil and recycle the spent caustic at an eventual cost savings to the company. DuPont-Edge Moor presently sells a large portion of the ferric chloride previously dumped as waste and recycles most of the hydrochloric acid which was also a waste. Philadelphia has reclaimed over 20 sq km (5000 acres) of barren strip mine land in middle Pennsylvania with sewage sludge which would have gone to sea. Each dumper represented a unique situation. It has been shown that U.S. EPA's environmental regulations are sufficient to control and limit ocean dumping. Further, industries and municipalities do have environmentally and economically sound alternatives to ocean dumping. (See also W87-07396) (Lantz-PTT)
W87-07410

EFFECTS OF SEWAGE SLUDGE DUMPING ON CONTINENTAL SHELF BENTHOS,
Environmental Protection Agency, Annapolis, MD.
For primary bibliographic entry see Field 5C.
W87-07411

SEWAGE SLUDGE DUMPING IN THE MID-ATLANTIC BIGHT IN THE 1970S: SHORT-, INTERMEDIATE-, AND LONG-TERM EFFECTS,
Millersville State Coll., PA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5C.
W87-07412

MARINE AMOEBAE (PROTOZOA: SARCODINA) AS INDICATORS OF HEALTHY OR IMPACTED SEDIMENTS IN THE NEW YORK BIGHT APEX,
National Marine Fisheries Service, Oxford, MD. Northeast Fisheries Center.
For primary bibliographic entry see Field 5C.
W87-07413

TESTING AND EVALUATION OF STABILIZED COAL WASTES FOR OCEAN DISPOSAL,
State Univ. of New York at Stony Brook. Coll. of Engineering and Applied Sciences.
For primary bibliographic entry see Field 7B.
W87-07414

DIFFUSION OF CALCIUM AND SULFATE IONS IN STABILIZED COAL WASTES,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
I. W. Duedall, J. S. Buyer, M. G. Heaton, S. A. Oakley, and A. Okubo.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 375-395, 11 fig, 4 tab, 18 ref.

Descriptors: *Industrial wastes, *Calcium, *Sulfates, *Coal, *Waste disposal, *Ocean dumping, *Model studies, Seawater, Fly ash, Sludge, Powerplants.

Fly ash and scrubber sludge wastes (mainly calcium sulfite hemihydrate and gypsum) from coal-burning power plants were stabilized with lime to produce solid, brick-like forms. The flux of calcium (Ca(2+)) and sulfate (SO4(2-)) ions from blocks placed in test tanks containing seawater or estuarine water was measured for 168 days for one waste and 147 for another. Initially, fluxes of Ca(2+) and SO4(2-) leaving the blocks about 10 to the minus 7th power mole/sq mm/day for two different wastes with approximately the same fly ash:sludge ratio of 1:1; at the end of the experiment, fluxes had decreased to 2 times 10 to the minus 8th power to 3 times 10 to the minus 8th power mole/sq mm/day. A one-dimensional model based on diffusion was developed to describe the fluxes. The model predicts diffusivities of 1.2 times 10 to the minus 9th to 3 times 10 to the minus 9th power sq cm/sec and the depth (x sub c) of penetration of the diffusion process: in 10 days, x sub c=2.1-3.3 cm. The results of the model suggest that stabilized coal waste blocks will have a long life in seawater if erosion and biological processes do not have a major effect on block properties. (See also W87-07396) (Author's abstract)
W87-07415

SCIENTIFIC STRATEGY FOR INDUSTRIAL AND SEWAGE WASTE DISPOSAL IN THE OCEAN,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
I. W. Duedall, B. H. Ketchum, P. K. Park, and D. R. Kester.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 399-413, 6 fig, 1 tab, 18 ref.

Descriptors: *Wastewater disposal, *Ocean dumping, *Industrial wastes, *Research priorities, Wastewater disposal, Marine environment, Fate of pollutants, Path of pollutants.

Ocean dumping of industrial and sewage wastes will continue into the future. The scientific evaluation of ocean dumping requires a strategy of fundamental research in biological, chemical, physical and sedimentogical processes in marine systems, investigations of waste characterization, studies of toxicity mechanisms and sublethal and biological effects based on laboratory microcosm and fieldwork, determination of fates and pathways of wastes, and the development of mathematical models describing biological, chemical, and physical processes. When possible and depending on the properties of the waste, dispersal deepwater dumpsites should be used for waste disposal instead of sites closer to shore. A program to recycle wastes will reduce the quantity of waste material produced as well as decrease the rate of depletion of those elements whose present abundance is low. Research into innovative solutions of waste disposal that minimize environmental impacts should be encouraged. (See also W87-07396) (Author's abstract)
W87-07416

AVOIDING FAILURE OF LEACHATE COLLECTION SYSTEMS AT HAZARDOUS WASTE LANDFILLS,
Little (Arthur D.), Inc., Cambridge, MA.
J. M. Bass.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84-235100. Price codes: A07 in paper copy, A01 in microfiche. EPA Report No. EPA-600/D-84-210, August 1984. 17p, 1 fig, 5 tab, 11 ref. EPA Contract 68-03-1822.

Descriptors: *Waste disposal, *Water pollution prevention, *Leachates, *Hazardous wastes, *Landfills, Water pollution sources, Drainage systems, Performance evaluation.

Failure of leachate collection systems is expected to be a problem in the operation of hazardous waste disposal facilities, just as failure of drainage systems has been a problem at agricultural sites. The principal failure mechanisms include sedimentation, clogging by biological, chemical and biochemical materials, and mechanisms which do not involve clogging including pipe deterioration, pipe displacement and exceeding design capacity. Operating experience with leachate collection systems indicates that all of the failure mechanisms have occurred in the field, although experience with chemical and biochemical precipitation is limited. In a survey of 22 waste disposal facilities which had leachate collection system problems, 14 experienced problems attributable to errors in design, construction or operation. The remaining 8 experienced problems that could likely have been avoided through system maintenance. Designing to avoid failure includes careful pipe location, fallback systems or redundancy, allowing for maintenance requirements and addressing specific failure mechanisms. Construction must involve adequate quality assurance and may require special construction techniques. Operation of leachate collection systems to avoid failure includes regular inspection and system maintenance to find and address problems before they become too serious. (Author's abstract)
W87-07430

BRICKS MANUFACTURED FROM SLUDGE,
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
J.-H. Tay.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 278-284, April 1987. 2 fig, 5 tab, 12 ref.

Descriptors: *Sludge utilization, *Waste disposal, *Bricks, Sludge ash, Compressive strength.

Sludge resulting from wastewater treatment plants creates problems of disposal. Generally, dewatered sludges are disposed of by spreading on the land or by landfilling. However, for highly urbanized cities, sludge disposal by landfilling might not be appropriate due to land limitation. Incineration might be an alternative solution. However, a substantial amount of ash will be produced after the burning process and must be disposed of by other means. This paper presents the results of the utilization of dried sludge and sludge ash as brick making materials. The maximum percentages of dried sludge and sludge ash that can be mixed with clay for brick making are 40% and 50% respectively. The compressive strength of the bricks are 87.2 N/sq mm for 0% sludge, decreasing to 37.9 M/sq mm for 40% dried sludge, and 69.4 N/sq mm for 50% sludge ash. (See also W87-07498) (Author's abstract)
W87-07494

SLUDGE ASH AS FILLER FOR PORTLAND CEMENT CONCRETE,
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
J.-H. Tay.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 345-351, April 1987. 3 fig, 4 tab, 18 ref.

Descriptors: *Sludge utilization, *Waste disposal, *Sludge, *Portland cement, *Concretes, Fillers, Sludge ash, Cement.

Sludge is an unavoidable by-product of wastewater treatment. For highly urbanized cities, incineration of sludge might be a viable means of sludge disposal; however, a substantial amount of ash is produced by the burning process and must be disposed of by other means. The feasibility of using sludge ash as filler in concrete is studied, and the effects of sludge ash on the properties of fresh and hardened concrete are investigated. The results indicate that the sludge ash could be used as a partial replacement for cement in concrete. (See also W87-07494) (Author's abstract)
W87-07498

SLUDGE COMPOST RECYCLING: THE PHILADELPHIA STORY,
Philadelphia Streets Dept., PA.
M. Miller.
Journal of Soil and Water Conservation JWSCA3, Vol. 41, No. 5, p 292-296, September-October 1986.

Descriptors: *Sludge disposal, *Compost, *Recycling, *Waste recovery, *Waste management, *Philadelphia, *Waste disposal, Sludge, Case studies, Land disposal, Land reclamation, Costs, Economic aspects, Planning, Marketing, Soil amendments, Strip mines.

Philadelphia's Water Department has developed a comprehensive sludge management program in which compost products are recycled in four major utilization programs: (1) marketing; (2) bulk applications to land; (3) stripmine reclamation; and (4) giveaway. After seven years of experience, the program serves as a working model for large-scale municipal sludge compost recycling. Composting is a five-step process involving mechanical dewa-

tering, blending with wood chips, aerobic digestion, curing, and screening; about 200 dry tons of sludge are processed daily. Products are marketed in four programs; products include Earthlife (for greenhouse and landscaping use), Dry Philorganic (for land application and soil amendment), and Mine Mix (for bulk stripmine application). The bulk application program uses a mixture of compost and screened Mine Mix to amend agricultural soils and revegetate landfill cover. The giveaway program allows homeowners, landscape gardeners, and other small-scale users to collect their own compost (Philorganic) at the wastewater treatment plants at no cost. The stripmine reclamation program targets thousands of acres of land left barren from surface mining activity. A new, large-scale composting facility is currently being constructed in anticipation of increased sludge production (360 tons daily by 1988). (Doria-PTT)
W87-07559

ZINC, COPPER AND NICKEL CONCENTRATIONS IN RYEGRASS GROWN ON SEWAGE SLUDGE-CONTAMINATED SOILS OF DIFFERENT PH,
Rothamsted Experimental Station, Harpenden (England).
J. R. Sanders, S. P. McGrath, and T. M. Adams.
Journal of the Science of Food and Agriculture JSFAAE, Vol. 37, No. 10, p 961-968, October 1986. 2 fig, 4 tab, 13 ref.

Descriptors: *Zinc, *Copper, *Nickel, *Ryegrass, *Land disposal, *Sludge disposal, *Hydrogen ion concentration, *Path of pollutants, *Wastewater, Water pollution sources, Water pollution effects, Soil types, Heavy metals, Acidity, Soil chemistry, Crop yield, Crop production, Chelating agents, Greenhouses, Toxicity, Soil texture, Statistical analysis, Correlation coefficient.

Sewage sludge containing high concentrations of zinc, copper, and nickel were added separately to samples of two soils (a silty clay loam and a sandy loam) on which pH levels between 4.5 and 7.5 had been established; there were also treatments with either sludge of low metal content or no-sludge. Soil-sludge mixtures were either continuously cropped with ryegrass or kept upcropped in pots in the greenhouse for six months. Zinc and nickel concentrations in 0.1 M calcium chloride extracts of soils from the cropped pots and in solutions displaced from the fallow pots decreased with increasing pH over the range tested, but copper concentrations remained steady above pH 5.5; individual metal concentrations in ryegrass tops followed the same pattern with pH as those in extracted solutions. Squared correlation coefficients between shoot metal concentrations and concentrations of metals in EDTA, DPTA, or calcium chloride extracts or displaced solutions, when taken over all soil, pH, and sludge treatments, were > 0.60 ($P < 0.001$). Ryegrass yield reductions occurred on soils contaminated with each of the three metal sludges when soil pH was 5.5 or below. It is concluded that a pH of 6.0 is generally satisfactory to guard against phytotoxic effects for these three metals, though the resulting metal concentrations in herbage, particularly of copper, may lead to excessive uptake by grazing animals. (Author's abstract)
W87-07581

NEW TREATMENT OF SEWAGE SLUDGE BY DIRECT THERMOCHEMICAL LIQUEFACTION,
National Research Inst. for Pollution and Resources, Kawaguchi (Japan).
For primary bibliographic entry see Field 5D.
W87-07585

BEER AND BIOMASS,
Bechtel Ltd., London (England).
For primary bibliographic entry see Field 5D.
W87-07586

5F. Water Treatment and Quality Alteration

USE OF REGRESSION MODELS TO LINK RAW WATER CHARACTERISTICS TO TRIHALOMETHANE CONCENTRATIONS IN DRINKING WATER,
Evaluation Research Corp., Oak Ridge, TN.
C. M. Morrow, and R. A. Minear.
Water Research WATRAG, Vol. 21, No. 1, p 41-48, January 1987. 6 fig, 9 tab, 16 ref. Water Resources Research Center Grant 14-34-0001-1145.

Descriptors: *Chlorination, *Model studies, *Regression models, *Raw water, *Trihalomethanes, *Water treatment, *Water quality, *Tennessee, *Drinking water, Bromine, Bromides, Detection limits, Field tests, Prediction, Sample preparation.

The effect of raw water bromide on the formation and distribution of trihalomethanes (THMs) in finished drinking water was examined. Twenty major water supplies in East Tennessee were selected for their significant levels of bromine-containing THMs, as demonstrated by previous studies. The cities were sampled quarterly for raw water pH, temperature, NVTOC, and bromide content, as well as finished water pH, NVTOC, and applied chlorine dose, coupled with conjunctive measurement for 7-day THMs. Few data for bromide levels in natural waters are currently available since most conventional colorimetric applications lack desired sensitivity, as does direct ion chromatography (IC). Although Fishman's kinetic permanganate method is adequate in the 10-100 microp/L range, it is time-consuming, and prone to certain interferences. An IC method using a sample preconcentration column was evaluated. The method produced a 1 microgram(ug)/L minimum detection level using deionized water based standards, with 3% relative precision completed at a standard concentration of 1000 ug/L. Bromide levels in the raw waters sampled were found to range from 10 to 225 ug/L. Concurrent with the field sampling, laboratory chlorination experiments were conducted using Tennessee River water, under controlled laboratory conditions of bromide level, chlorine dose, pH, ionic strength, temperature, and organic precursor concentration. Resultant THM formations were monitored over a 96 h reaction period. The results concurred with observations made in previous work by such researchers as Bird and Rook. Nonlinear regression models for THM formation were generated using the laboratory chlorination data with respect to pH, temperature, chlorine dose, bromide, and NVTOC level. Actual values for these variables were substituted into the regression models, using the seasonal field data. Resultant predictive THM values were then compared with actual THM values for those data sampled. In general, these models were found to give acceptable fits. Overall 74.1% of the predicted values were within + or - 15% of the measured values. (Author's abstract)
W87-06753

EFFECT OF WATER TREATMENT ON THE SPECIATION AND CONCENTRATION OF LEAD IN DOMESTIC TAP WATER DERIVED FROM A SOFT UPLAND SOURCE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. J. de Mora, R. M. Harrison, and S. J. Wilson.
Water Research WATRAG, Vol. 21, No. 1, p 83-94, January 1987. 5 fig, 6 tab, 29 ref.

Descriptors: *Plumbing, *Glasgow, *Tap water, *Water treatment, *Lead, *Stagnation, Speciation, Heavy metals, Solubility, Aluminum, Colloids, Plumbosolvency, Domestic water, Construction materials, Scotland, Water supply, Water properties.

Thirty-minute stagnation tapwater samples were collected from five households with lead plumbing near Glasgow, Scotland. Four sites were supplied with water from the same source, but subject to different levels of treatment ranging from no treatment whatever at one extreme, to coagulation, filtration, chlorination and pH adjustment at the other. Water treatment processes greatly reduce the plumbosolvent properties of the water as indicated by 30 min stagnation, and it is postulated that the removal of colloidal hydrous iron oxide/humic acid species is particularly important in this regard. The presence of appreciable levels of colloidal aluminum in some alum-coagulated water samples does not appear to influence plumbosolvency. (Author's abstract)
W87-06758

COAGULATING BEHAVIORS OF FE(III) POLYMERIC SPECIES-I: PREFORMED POLYMERS BY BASE ADDITION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2K.
W87-06762

COAGULATING BEHAVIORS OF FE(III) POLYMERIC SPECIES-II: PREFORMED POLYMERS IN VARIOUS CONCENTRATIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2K.
W87-06763

TRAINING PANELISTS FOR THE FLAVOR PROFILE ANALYSIS METHOD,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5G.
W87-06765

MODELING TOC REMOVAL BY GAC: THE GENERAL LOGISTIC FUNCTION,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 33-37, January 1987. 9 fig, 4 tab, 9 ref.

Descriptors: *Mathematical models, *General Logistic Function, *Model studies, *Organic carbon, *Model studies, *Activated carbon, *Water treatment, *Data interpretation, Mathematical equations, Mathematical analysis, Isotherms, Breakthrough, Performance evaluation, Carbon, Adsorbents, Mathematical studies, Adsorption.

Various models have been proposed to predict the performance of granular activated carbon (GAC) for single and bisolute systems, including the use of a bed depth service model for interpreting data for operation of adsorption beds to remove total organic carbon (TOC). This model is essentially the simple or symmetrical logistic function. The generalized logistic function is applied to TOC removal and data from GAC, incorporating the inverse of the Freundlich isotherm slope. Thus the model is useful when the breakthrough curve is nonsymmetrical. (Author's abstract)
W87-06766

PREVENTING THE FORMATION OF TRIHALOMETHANES IN FLORIDA GROUNDWATER,
Camp, Dresser and McKee, Inc., Boston, MA.
J. C. Thompson, and J. J. Ameno.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 38-42, January 1987. 6 fig, 2 tab, 2 ref.

Descriptors: *Water treatment, *Groundwater, *Pollutants, *Aquifers, *Trihalomethanes, *Color removal, *Water quality control, Groundwater quality, Water quality, Florida, Biscayne Aquifer, Methane, Color, Optical properties, Coagulation, Chemical coagulation, Water softening, Ammonia.

The Broward County (Florida) Utilities Department was faced with the problem of reducing color in water from the Biscayne Aquifer and simultaneously controlling the potential for the

formation of excessive trihalomethanes (THMs). The solution was to provide a short coagulation period, using ferric chloride, followed by softening to remove color plus providing a chloramine residual by adding ammonia. The improved treatment processes resulted in color control and THM levels of less than half the maximum contaminant level. (Author's abstract)
W87-06767

COMPARING GEL PERMEATION CHROMATOGRAPHY AND ULTRAFILTRATION FOR THE MOLECULAR WEIGHT CHARACTERIZATION OF AQUATIC ORGANIC MATTER,
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W87-06768

DEVELOPING HALOFORM FORMATION POTENTIAL TESTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
B. Batchelor, D. Fusilier, and E. H. Murray.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 50-55, January 1987. 10 fig, 2 tab, 8 ref.

Descriptors: *Pollutant identification, *Trihalomethanes, *Water treatment, *Chemical analysis, Water quality control, Water treatment facilities, Chemical potential, Chemical reactions, Halogens, Chlorine, Data acquisition, Testing procedures, Iodine, Bromine, Spectrophotometry, Haloforms, Humic acids, Kinetics, Comparison studies, Organic carbon, Performance evaluation.

There is a need for accurate, rapid, and easily measured surrogate parameters for trihalomethane formation potential (THMFP) to aid in the control of water treatment plants. Four haloform potential (HFP) tests were developed to meet this need. They are based on replacing chlorine in the THMFP test with iodine or bromine. The iodoform or bromoform produced by reaction with natural organic matter can be measured with a spectrophotometer rather than a gas chromatograph. Kinetics of formation of iodoform and bromoform were studied at 25, 50, and 100 C using solutions of commercial humic acid. Correlation experiments showed that the HFP tests were better able to predict THMFP than conventional surrogate parameters, total organic carbon, and ultraviolet absorption. On the basis of ease of analysis, analysis time, and the ability to predict THMFP, the HFP tests appear to be improved surrogate parameters for THMFP. (Author's abstract)
W87-06769

DESIGNING A COST-EFFICIENT AIR-STRIPPING PROCESS,
N. Nirmalakhandan, Y. H. Lee, and R. E. Speece.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 56-63, January 1987. 15 fig, 3 tab, 13 ref.

Descriptors: *Air stripping, *Volatile organic compounds, *Mathematical equations, *Water treatment, *Organic compounds, *Simulation analysis, *Cost analysis, Economic aspects, Costs, Capital costs, Operating costs, Onda's correlation, Computer models, Simulation, Cost-benefit analysis, Mathematical studies, Temperature effects, Temperature, Optimization.

The air stripping of volatile organic chemicals (VOCs) from water was optimized by taking account both of capital and operating costs. By using Onda's correlation for mass transfer coefficient and computer simulations, optimal water loading rates and air-to-water ratios were established for five representative VOCs. The overall treatment cost appeared to be relatively insensitive to changes in the operating variables in the vicinity of the optimum region, but increased rapidly as the conditions deviated from the optimum region. It was also observed that the overall treatment cost was very sensitive to capital cost, but not significantly affected by power costs. The treatment cost dropped almost linearly as temperature increased. (Author's abstract)
W87-06770

BIOREGENERATION OF GAC USED TO TREAT MICROPOLLUTANTS,
Houston Univ., TX. Dept. of Civil Engineering.
G. E. Speitel, and F. A. DiGiano.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 64-73, January 1987. 10 fig, 3 tab, 20 ref. NSF Grant CEE-8213418.

Descriptors: *Bioregeneration, *Water treatment, *Activated carbon, *Model studies, *Isotope studies, *Organic compounds, *Micropollutants, Rehabilitation, Microbiological studies, Carbon, Adsorbents, Sorption, Phenol, Paranitrophenol, Mathematical models, Mathematical equations, Pollutants, Regeneration, Experimental data.

Microbial activity in granulated activated carbon (GAC) has the potential of extending the service life of GAC beds through in situ biological regeneration of sorption sites. Bioregulation with phenol and paranitrophenol (PNP) was examined over the concentration range of 20-100 micrograms/liter and was measured using radiochemical analytical techniques. Bioregulation ranged from 5 to 22% over a 10-day period and typically showed a lag phase, followed by rapid regeneration, and finally a fairly constant, much lower rate. Differences in bioregeneration rate as a function of column position were slight with phenol as the substrate, but substantial with PNP, for which bioregeneration was greatest at the influent end and smallest at the effluent end. The experimental results, in combination with mathematical modeling, suggest that bioregeneration can significantly affect the removal of low concentration of synthetic organic chemicals. (Author's abstract)
W87-06771

DESIGN CONSIDERATIONS FOR GAC TREATMENT OF ORGANIC CHEMICALS,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, D. W. Hand, H. Arora, and B. W. Lykins.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 74-82, January 1987. 6 fig, 5 tab, 36 ref. NSF Grants CEE 79-24589 and CEE 83-00213, EPA Cooperative agreement CR811150-01-0.

Descriptors: *Design criteria, *Activated carbon, *Organic compounds, *Water treatment, *Model studies, *Drinking water, Adsorbents, Solutes, Correlation analysis, Mathematical equations, Mathematical studies, Isotherms, Mass transfer, Performance evaluation, Mathematical models, Comparison studies.

Granular activated carbon (GAC), a technique for the removal of organics and synthetic organic compounds which cause unacceptable tastes and odors from drinking water, is expensive especially if the design does not take empty bed contact time and process flow configuration into consideration. Procedures with which to determine preliminary fixed-bed adsorber design calculations for single solutes were described. Correlations were proposed and verified to determine single-solute isotherm and mass-transfer parameters. These correlations were used in combination with a simplified version of a mass-transfer model to calculate mass transfer zone lengths and the maximum amount of water that may be treated. The calculated results were then used to select the optimum fixed-bed adsorber operation. The results from this simplified procedure were compared with actual pilot-plant and full-scale data to demonstrate the validity of the developed procedure. (Wood-PTT)
W87-06772

DESIGNING WATER TREATMENT FACILITIES,
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
R. D. G. Monk, and J. F. Willis.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 45-57, February 1987. 12 fig, 2 tab, 35 ref.

Descriptors: *Water treatment facilities, *Water treatment, *Design criteria, *Design standards, *Cost-benefit analysis, *Economic aspects, Cost analysis, Costs, Operating costs, Construction costs, Mixing, Engineering, Flocculation, Evaluation, Clarifiers, Clarification, Filters, Filtration, Scour, Backwash, Regulations, Legal aspects.

Advances in the technology of water treatment allow significant cost savings in the construction and operation of treatment facilities. The cumulative effect of these progressive techniques has not been fully assimilated by all engineers, managers, operators, and officials of state regulatory agencies. Current and past water treatment practices were reviewed and it was concluded that there are practical means of increasing existing water plant production or designing more cost-effective plants and of reducing operating costs. In order to optimize the complete water treatment system taking advantage of modern technology, especially flash mixers, flexible flocculation practices, improved inlet-outlet designs for clarifiers, optimized clarifier-filter design, filter aids, air-wash scour for backwashing, and monitors for filter head loss, was recommended. It was suggested that regulatory standards, particularly those that are technology-based, should be reexamined to support cost-effective design and to reflect modern engineering and operating practices. (Wood-PTT)
W87-06775

MITIGATING COPPER PITTING THROUGH WATER TREATMENT,
Copper Development Association, Inc., Greenwich, CT.
A. Cohen, and J. R. Myers.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 58-61, February 1987. 6 fig, 1 tab, 4 ref.

Descriptors: *Water treatment, *Corrosion control, *Copper, *Plumbing, *Corrosion, *Pipes, *Pipelines, Ohio, Fort Shawnee, Water transport, Domestic water, Hydrogen ion concentration, Sodium compounds, Sodium carbonate, Carbon dioxide, Chemical treatment.

In July 1978, the first of about 25 pitting failures occurred in the residential plumbing systems of private homes and condominiums in the Highland Greens subdivision of Fort Shawnee, Ohio. An investigation showed that the water distributed to the community promoted and supported the pitting corrosion. Treatment of the water supply by addition of sodium carbonate to increase pH and to eliminate the dissolved carbon dioxide was introduced. Pitting attack diminished almost immediately, and new reports of leakage ceased within six months. Two corrosion test loops containing 100 tube specimens were exposed to raw and treated water. The 50 specimens exposed to the treated water showed no pitting attack. About 20 percent of the 50 tubes exposed to raw water displayed major pitting, with lesser but still observable attack in the remainder of the tube specimens. (Author's abstract)
W87-06776

INFLUENCE OF BUFFER CAPACITY, CHLORINE RESIDUAL, AND FLOW RATE ON CORROSION OF MILD STEEL AND COPPER,
Environmental Science and Engineering, Inc., Gainesville, FL.
R. A. Pisigan, and J. E. Singley.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 62-70, February 1987. 16 fig, 4 tab, 33 ref.

Descriptors: *Corrosion, *Water treatment, *Steel, *Copper, *Residual chlorine, *Buffers, *Chemical properties, *Corrosion control, *Flow rates, *Chlorine, Flow, Hydrogen ion concentration, Alkalinity, Ions, Dissolved solids, Oxidation, Chemical reactions.

The corrosion rates of mild steel decreased as buffer capacity was increased with pH at constant alkalinity. The corrosion-promoting effect of ionic strength, however, appeared to predominate over

the buffer action in water systems with relatively high total dissolved solids and chloride levels. The enhanced corrosion of mild steel and copper due to a free chlorine residual was related to the strong oxidation potentials of hypochlorous acid and hypochlorite ions. Corrosion rates were faster with higher flow rates, but other hydraulic and environmental factors also need to be considered when corrosivities are compared. (Author's abstract)
W87-06777

CORROSION MONITORING AND CONTROL IN THE PACIFIC NORTHWEST,
Washington Univ., Seattle.
S. H. Reiber, J. F. Ferguson, and M. M. Benjamin.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 71-74, February 1987. 6 fig, 3 tab, 9 ref. EPA Cooperative agreement CR-810508.

Descriptors: *Corrosion control, *Corrosion, *Water quality, *Plumbing, *Regression analysis, Monitoring, Evaluation, Pacific northwest, Seattle, Copper, Domestic water, Hydrogen ion concentration, Residual chlorine, Chlorine, Mathematical studies, Statistics, Water quality control, Statistical analysis, Mineral water.

An 18-month monitoring program evaluated the relationship between copper plumbing corrosion and variations in delivered water quality in several communities in the Pacific Northwest. Significant relationships were found for copper corrosion rate dependence on pH and free chlorine residual. Regression analysis provided a statistical means of identifying the important predictors of copper corrosion rates in low mineral waters, such as that found in the Seattle water system. It was concluded that for water of low alkalinity and buffer capacity and low mineral content, the oxide film layer on the aged copper surfaces provides protection from corrosion which, when compared with the surfaces of new pipes, reduces the corrosion rate by about 50%. Extrapolation from the Seattle corrosion experience to water sources of higher mineral content may be unsuccessful because of competing chemical equilibriums. (See also W87-06779) (Wood-PTT)
W87-06778

MODELING BISUBSTRATE REMOVAL BY BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. Namkung, and B. E. Rittmann.
Biotechnology and Bioengineering BIBIAU, Vol. 29, No. 2, p 269-278, February 1987. 8 fig, 2 tab, 23 ref. EPA Cooperative agreement CR 810462.

Descriptors: *Water treatment, *Biomass, *Biofilms, *Bisubstrates, *Model studies, Water quality control, Mathematical models, Mathematical equations, Mathematical studies.

A bisubstrate secondary utilization model is based on the concept that an individual substrate can be used not only by the biomass made by its utilization but also by the biomass made from the utilization of the other substrate. When substrate concentrations are low, a key factor is having sufficient substrate to initiate biofilm growth. Modeling results for three characteristic cases demonstrate that satisfying a total S sub min concentration for a bisubstrate system is the necessary condition for initiating biofilm growth and simultaneous utilization of both substrates. Because having more than one substrate supporting biofilm growth enhances the removal of each compound, the utilization rate of a specific compound can be increased by the concentration of the other compounds, and the total S sub min concentration can be less than the weighted average of individual S sub min values. (Author's abstract)
W87-06785

CHANGES IN THE CHEMICAL COMPOSITION OF DRINKING WATER AFTER WELL INFILTRATION IN AN UNCONSOLIDATED SANDY AQUIFER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
For primary bibliographic entry see Field 4B.
W87-06818

ION-EXCHANGE SOFTENING OF HIGH-SOLIDS WATERS,
Diamond Shamrock Corp., Redwood City, CA.
For primary bibliographic entry see Field 5G.
W87-06898

EVALUATION OF AN ELECTROLYTIC WATER CONDITIONING DEVICE FOR THE ELIMINATION OF WATER-FORMED SCALE DEPOSITS IN DOMESTIC WATER SYSTEMS,
Texas Univ. at Austin. Center for Research in Water Resources.
C. A. Sorber, and S. R. Valenzuela.
CRWR Paper 186, May 1982. Technical Report. 88 p, 25 fig, 12 tab, 56 ref.

Descriptors: *Water treatment, *Electrolysis, *Water conditioning, *Domestic water, *Scale prevention, Scaling, Flow rates, Hydrogen ion concentration, Hardness, Alkalinity.

An electrolytic water conditioning device said to cause removal of previously formed scale deposits and prevention of new deposits was evaluated to determine its effectiveness and to provide a theoretical explanation of its effects. Continuous flow experiments were conducted in the laboratory at two flow rates to observe any removal of scale deposits from encrusted pipe segments. In a 1500 hr continuous flow experiment, there was no consistently reproducible evidence that use of an electrolytic water treater could cause dissolution of or otherwise remove existing scale deposits in a test pipe segment under controlled laboratory conditions with municipally softened Austin tap water. Static experiments were conducted to determine any changes in water characteristics such as pH, alkalinity, and hardness as water was continuously treated in the conditioner. The electrolytic water conditioning device tested caused precipitation of scale forming compounds within the unit by the electrolysis of water and changes in the acid-base equilibria of the species present in tap water. Under some conditions, these changes in equilibria could theoretically cause dissolution of previously formed scale deposits downstream of the device. The manufacturer's explanation of the operation of the device, that naturally occurring colloidal particles would collect in the unit, was not substantiated since most naturally occurring particles are negatively charged and no buildup on the positively charged anode occurred. Continued usage of the device tested resulted in considerable deterioration of the graphite anode, which in actual usage would require frequent replacement. Any effect of an electrolytic water conditioner depends on the chemical characteristics of the water being treated and the scale deposit to be removed. (Lantz-PTT)
W87-06939

WATER TREATMENT PRINCIPLES AND DESIGN,
Montgomery (James M.), Inc., Pasadena, CA.
J. A. Montgomery.
John Wiley and Sons, New York, New York. 1985. 696 p.

Descriptors: *Water treatment, *Water quality, Water treatment facilities, Flocculation, Coagulation, Sedimentation, Filtration, Ion exchange, Adsorption, Design standards, Cost analysis, Microbiological studies, Odor control, Taste.

This book provides detailed descriptions of processes such as coagulation and flocculation, sedimentation, filtration, ion exchange, adsorption, gas transfer, and disinfection. It offers extensive discussion on facilities design criteria, including component description and organization, process control, and materials. It encompasses all aspects of engineering a treatment facility from predesign and plant siting through cost estimating and operation and maintenance requirements. It also provides complete coverage of the physical and chemical properties of water, aquatic microbiology, corrosion, and the control of inorganics, organics, and tastes and odors in water. A working handbook for engineers, students, and practioners, it covers both the practical and theoretical aspects of water quality, treatment processes, and facility design. (Lantz-PTT)
W87-06943

COMPUTERIZATION IN THE WATER AND WASTEWATER FIELDS.
For primary bibliographic entry see Field 5D.
W87-06965

OPERATIONS CONTROL USING MICRO-COMPUTERS,
Michigan Univ., Ann Arbor. School of Public Health.
For primary bibliographic entry see Field 5D.
W87-06969

USING COMPUTERS FOR PROCESS CONTROL AT SMALL TREATMENT PLANTS,
Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 5D.
W87-06970

USING COMPUTERS FOR PROCESS CONTROL AT LARGE TREATMENT PLANTS,
McNamee, Porter and Seeley, Ann Arbor, MI.
For primary bibliographic entry see Field 5D.
W87-06971

POWER USAGE OPTIMIZATION AND CONTROL BY COMPUTER,
McNamee, Porter and Seeley, Ann Arbor, MI.
For primary bibliographic entry see Field 5D.
W87-06976

WATER TREATMENT PLANT OPERATION VOLUME I: A FIELD STUDY TRAINING PROGRAM.
California State Univ., Sacramento. School of Engineering.
Foundation of the California State University, Sacramento, California. 1983. 655 p. EPA Grant T-901361-01-0.

Descriptors: *Water treatment facilities, *Water treatment, *Training, Water management.

The purposes of this water treatment field study training program are to: (1) develop new qualified water treatment plant operators, (2) expand the abilities of existing operators, permitting better service to both their employers and the public, and (3) prepare operators for civil service and certification examinations. To provide the knowledge and skills needed to operate and maintain water treatment plants as efficiently and effectively as possible, experienced water treatment plant operators prepared the material in each chapter. Water treatment plants vary from city to city and from region to region. The material contained in this program is presented to provide an understanding of the basic operation and maintenance aspects of water treatment plants, and information to help analyze and solve operation and maintenance problems. (See also W87-07036 thru W87-07046) (Lantz-PTT)
W87-07035

WATER TREATMENT PLANT OPERATOR,
California State Univ., Sacramento.
K. Kerri.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 1-14, 2 fig, 1 tab.

Descriptors: *Water treatment, *Water treatment facilities, *Personnel, *Training, Maintenance, Public relations.

This chapter explains the type of work done by water treatment plant operators, describes where

to look for jobs in this profession, and describes how one can learn to do the jobs performed by water treatment plant operators. Water softening, iron and manganese control, operation and maintenance, supervision and administration, public relations and safety are all aspects of an operators job which are described. (See also W87-07035) (Lantz-PTT)
W87-07036

WATER SOURCES AND TREATMENT,
B. Ellsworth.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 15-37, 1 fig, 1 tab.

Descriptors: *Water supply, *Training, *Water treatment, Water resources development, Water quality, Drinking water.

This chapter describes the importance of water, identifies the various sources of water, outlines the procedures of a sanitary survey, evaluates the suitability of a water source for drinking purposes and as a general water supply, and identifies water quality problems and treatment processes to solve the problems. Direct runoff, groundwater, lakes and reservoirs, reclaimed water, precipitation and the Safe Drinking Water Act are discussed in depth. (See also W87-07035) (Lantz-PTT)
W87-07037

RESERVOIR MANAGEMENT AND INTAKE STRUCTURES,
R. H. Barnett.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 39-90, 20 fig.

Descriptors: *Reservoir operation, *Intake gates, *Hydraulic structures, *Training, *Water treatment, *Water quality control, Water quality, Monitoring, Reservoirs.

This chapter describes the importance of reservoir management, identifies causes of reservoir water quality problems, and justifies the need for a reservoir management program. It explains how to implement the appropriate methods of reservoir management and water quality improvement, helps develop a laboratory and monitoring program, describes the purpose of intake structures, identifies various types of intake structures, gates, and screens, teaches how to safely operate, maintain and troubleshoot intake facilities, and keep necessary records on the operation and maintenance of reservoir water quality management programs and intake structures. (See also W87-07035) (Lantz-PTT)
W87-07038

COAGULATION AND FLOCCULATION,
J. Beard.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 91-142, 15 fig, 4 tab, append.

Descriptors: *Water treatment, *Training, *Coagulation, *Flocculation, Jar tests, Chemical treatment, Sampling, Physicochemical treatment.

This chapter describes the need for coagulation and flocculation, and how to: (1) perform a jar test, (2) select the proper coagulant and determine the dosage, (3) adjust chemical feed rates, (4) select optimum speeds for flash mixers and flocculators, (5) collect samples from the coagulation and flocculation basins, (6) start up and shut down a coagulation/flocculation process, and (7) operate and maintain coagulation/flocculation processes. (See also W87-07035) (Lantz-PTT)
W87-07039

SEDIMENTATION,
J. Beard.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 143-194, 28 fig, 3 tab, append.

Descriptors: *Sedimentation, *Water treatment, *Training, Water quality control, Sedimentation basins, Process control, Sampling, Monitoring.

Identified in this chapter are factors affecting the performance of sedimentation basins. Various types of sedimentation basins and how they work, and the start up and shut down of sedimentation basins are discussed. How to: operate and maintain a sedimentation process and basins, collect samples and analyze results for a sedimentation process, keep records of a sedimentation process and basins, and safely perform these duties around a sedimentation basin are presented. (See also W87-07035) (Lantz-PTT)
W87-07040

FILTRATION,
J. Beard.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 195-246, 21 fig, 4 tab.

Descriptors: *Water treatment, *Filtration, *Water quality control, *Training, Potable water, Filters, Maintenance, Process control.

The various types of potable water filters and how they work are described. Explained, is how other treatment processes affect the performance of the filtration process, and how to: operate and maintain filters under normal and abnormal process conditions, start up and shut down filtration processes, and safely perform duties related to the various types of filters. (See also W87-07035) (Lantz-PTT)
W87-07041

DISINFECTION,
T. Ikesaki.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 247-332, 41 fig, 6 tab.

Descriptors: *Water treatment, *Water quality control, *Disinfection, *Training, Chlorine, Chlorination, Maintenance, Process control.

This chapter: describes the factors that influence disinfection; explains the process of disinfection using chlorine, hypochlorite and chlorine dioxide, and describes the breakpoint chlorination process. Identified are: the various points of chlorine application, and how to operate and maintain chlorination equipment, handle chlorine safety, select the proper chlorine dosage, start up and shut down chlorination equipment, troubleshoot chlorination systems, develop and conduct a chlorine safety program, and operate and maintain disinfection processes other than chlorine. (See also W87-07035) (Lantz-PTT)
W87-07042

CORROSION CONTROL,
J. Rossum.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 332-372, 14 fig, 7 tab.

Descriptors: *Corrosion control, *Water treatment, *Training, Water quality control, *Pipes, Calcium carbonate, Cathodes, Soil corrosion, Chemical analysis.

This chapter recognizes adverse effects of corrosion, describes how a pipe corrodes, determines if corrosion problems exist in a system, and determines if a water is saturated with calcium carbonate. How to: select the proper chemical to control corrosion, determine the proper chemical dose to control corrosion, use cathodic protection to control corrosion, prevent soil corrosion (external corrosion), and troubleshoot and solve corrosion problems are also discussed. (See also W87-07035) (Lantz-PTT)
W87-07043

TASTE AND ODOR CONTROL,
R. Bowen.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 373-411, 12 fig.

Descriptors: *Water treatment, *Training, *Taste, *Odor control, *Water quality control, Odor-producing algae, Process control, Taste-producing algae.

This chapter discusses the importance of taste and odor control, and identifies causes of tastes and odors. How to: locate sources of tastes and odors, treat or eliminate tastes and odors, and develop a taste and odor control strategy, are presented. (See also W87-07035) (Lantz-PTT)
W87-07044

PLANT OPERATION,
J. Beard.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 414-454, 7 fig, 14 tab.

Descriptors: *Water treatment facilities, *Operating policies, *Water treatment, *Training, *Maintenance, Flow regulators, Chemical treatment, Energy conservation, Public policy, Public participation.

Monitoring and controlling water treatment processes, and how to safely operate and maintain a water treatment plant is discussed in this chapter. Presented are instructions for how to: (1) regulate flows, (2) apply chemicals and adjust dosage, (3) prepare operating reports and records, (4) maintain equipment and facilities, (5) develop daily operating procedures for your plant, (6) respond to emergency conditions, (7) handle consumer complaints, and (8) implement energy conservation measures. (See also W87-07035) (Lantz-PTT)
W87-07045

LABORATORY PROCEDURES,
J. Sequeira.
IN: Water Treatment Plant Operation Volume I: A Field Study Training Program, California State University, Sacramento, California. 1983. p 456-525, 19 fig, 4 tab.

Descriptors: *Training, *Water treatment, *Monitoring, *Laboratories, Laboratory equipment, Sample preparation, Sample preservation, Alkalinity, Chlorine, Coliform, Hardness, Water quality control, Jar test, Hydrogen ion concentration, Turbidity.

This chapter discusses how to: work safely in a laboratory, operate laboratory equipment, collect representative samples and also preserve and transport the samples and also prepare samples for analysis. Described are the limitations of lab tests, and recognized are precautions to be taken for lab tests, and the recording of the test results. How to perform the following field or laboratory tests - alkalinity, residual chlorine, coliform, hardness, jar test, pH, temperature and turbidity - is also presented. (See also W87-07035) (Lantz-PTT)
W87-07046

IRON AND MANGANESE OXIDES IN FINNISH GROUND WATER TREATMENT PLANTS,
Helsinki Univ. (Finland). Dept. of Geology.
L. Carlson, and U. Schwertmann.
Water Research WATRAG, Vol. 21, No. 2, p 165-170, February 1987. 1 fig, 5 tab, 30 ref.

Descriptors: *Pollutant identification, *Precipitates, *Iron oxides, *Water treatment, *Water chemistry, *Water quality, *Manganese oxides, *Groundwater, *Finland, Water treatment facili-

ties, X-ray diffraction, Silicon, Ferrihydrites, Minerals.

Large amounts of ochreous precipitates are formed on aeration of Fe containing Finnish ground waters during purification for drinking purposes. Sixty-four precipitates were characterized chemically and mineralogically. X-ray diffraction (XRD) indicated that the Fe-rich precipitates consist mainly of a poorly ordered ferrihydrite (5 Fe2O3.9H2O) which only has 2-3 of the 6 XRD lines characteristic of better ordered ferrihydrite. The surface area ranges between 325 and 433 sq m/g corresponding to a particle size of 5 nm. The ferrihydrites contain 3-7% Si strongly associated twith the ferrihydrite as indicated by an i.r. absorption band at 960-975/cm which is associated to Fe-O-Si bonds. Si-containing ferrihydrite typically forms by rapid oxidation of ground waters with 1-23 mg/l Fe and 7-12 mg/l Si at pH 6-7. Very similar products formed in a simulation experiment in which artificial ground water with 20 mg/l Fe was oxidized in the presence of 12 mg/l Si. At <4 mg/l Si lepidocrocite (gamma-FeOOH) was formed showing that Si in the system prevents the formation of the more stable and better crystallized FeOOH forms. A transformation of 2-line ferrihydrite to better ordered ferrihydrite or goethite with time is indicated. The Mn-oxide birnessite was identified in black precipitates formed in one plant. (Author's abstract)
W87-07051

DETOXIFICATION OF CHLORINE DIOXIDE (CLO2) BY ASCORBIC ACID IN AQUEOUS SOLUTIONS: ESR STUDIES,
National Inst. of Radiological Sciences, Chiba (Japan).
T. Ozawa, and T. Kwan.
Water Research WATRAG, Vol. 21, No. 2, p 229-231, February 1987. 2 fig, 25 ref.

Descriptors: *Water chemistry, *Chlorination, *Chlorine dioxide, *Ascorbic acid, *Detoxification, *Electron spin resonance spectroscopy, *Free radicals, Solutions, Oxidation, Drinking water, Water treatment, Spectral analysis.

Chlorine dioxide (ClO2) which was easily prepared from dissolving sodium chlorite (NaClO2) in acidic aqueous solutions can oxidize L-ascorbic acid (AsA) to give the short-lived intermedieate, ascorbic acid free radical (AFR). The detection of the ascorbate radical was made by using the electron spin resonance (ESR) spectroscopy coupled with a rapid-mixing flow technique which enabled detection of radicals having a life-time of 5-100 ms at room temperature. This result indicates that the ascorbic acid becomes a suitable reagent for detoxification of the ClO2, which is remaining in drinking water, in the living body. (Author's abstract)
W87-07060

ALIPHATIC AND AROMATIC HALOCARBONS AS POTENTIAL MUTAGENS IN DRINKING WATER: PART 1. HALOGENATED METHANES,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5C.
W87-07073

ORGANICS, POLYMERS, AND PERFORMANCE IN DIRECT FILTRATION,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. K. Edzwald, W. C. Becker, and S. J. Tambini.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 167-185, February 1987. 9 fig, 5 tab, 29 ref. EPA Cooperative Agreement CR807034.

Descriptors: *Filtration, *Polyelectrolytes, *Water treatment, *Dissolved organic matter, *Chlorinated hydrocarbons, Polymers, Alum, Head loss, Flocculation, Turbidity, Humic acids, Spectroscopy.

The effects of raw water quality, chemical variables, and physical filter variables on direct filtration performance are examined. Cationic polyelectrolytes as sole coagulants are effective in treating low turbidity, colored waters by direct filtration. The polymer dosage is related to the raw water concentration of dissolved organic carbon. Cationic polymers can remove approximately 40% of the TOC and THM precursors. Filtration rate, direct filtration mode (in-line versus flocculation), and water temperature did not have a significant effect on removals. Greater removals were achieved by alum. Direct filtration with cationic polymers is a feasible method of treatment for waters containing 5 mg/L TOC or less. For waters containing relatively high concentrations of humic matter (color) or submicron size particles, direct filtration with a flocculation period produces less head loss development and longer filter runs. Direct filtration will begin to receive greater attention as the U.S. moves towards requiring filtration of surface waters. Finally, UV absorbance is an excellent surrogate parameter for monitoring the removals of TOC and THM precursors. (Author's abstract)
W87-07129

BATTLE OF THE NETWORK MODELS: EPILOGUE,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, E. D. Brill, J. Gessler, I. C. Goulter, and R. M. Jeppson.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 191-203, March 1987. 3 fig, 18 tab, 14 ref.

Descriptors: *Model studies, *Pipe networks, *Water distribution, Design criteria, Costs, Comparison studies, Engineering, Pipes, Plumbing.

Several models that can be used to optimally size water distribution pipes were applied to a hypothetical system. The results are summarized. The models produced solutions with costs that were within 10% of one another, although the solutions were quite different. While the models were helpful in sizing pipes, some manual calculations and a good deal of engineering judgment were required to apply them. (Author's abstract)
W87-07194

POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 7B.
W87-07279

MONITORING POWER PLANT WATER CHEMISTRY,
Babcock and Wilcox Co., Alliance, OH. Alliance Research Center.
For primary bibliographic entry see Field 7B.
W87-07280

CRITICAL OVERVIEW OF POWER STATION SAMPLING AND ANALYSIS OF WATER AND STEAM,
Westinghouse Electric Corp., Philadelphia, PA.
For primary bibliographic entry see Field 7B.
W87-07281

POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY,
Ontario Hydro Research Lab., Toronto.
For primary bibliographic entry see Field 7B.
W87-07283

STATUS OF CONTINUOUS MONITORING IN CENTRAL STATIONS,
Calgon Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07284

POWER PLANT WATER QUALITY INSTRUMENTATION: A GUIDELINE FOR OPERATION, CALIBRATION, AND MAINTENANCE,
Selby and Associates, Chicago, IL.
For primary bibliographic entry see Field 7B.
W87-07285

PROGRAM FOR STEAM PURITY MONITORING: 1. INSTRUMENTATION AND SAMPLING,
Westinghouse Research and Development Center, Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07286

QUANTIFICATION OF SODIUM, CHLORIDE, AND SULFATE TRANSPORT IN POWER-GENERATING SYSTEMS,
NWT Corp., San Jose, CA.
For primary bibliographic entry see Field 7B.
W87-07288

DETERMINATION OF ANIONS IN HIGH-PURITY WATER BY ION CHROMATOGRAPHY,
Calgon Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07289

IN-PLANT SYSTEM FOR CONTINUOUS LOW-LEVEL ION MEASUREMENT IN STEAM-PRODUCING WATER,
General Electric Co., San Jose, CA. Advanced Reactor Systems Dept.
For primary bibliographic entry see Field 7B.
W87-07291

HIGH-PURITY WATER QUALITY MONITORING BASED ON ION-SELECTIVE ELECTRODE TECHNOLOGY,
Claremont Men's Coll., CA.
For primary bibliographic entry see Field 7B.
W87-07292

EVALUATION OF POWER PLANT MEASUREMENT OF SODIUM IONS IN HIGH-PURITY MAIN STEAM AND FEEDWATER UTILIZING IN-LINE CONTINUOUS SPECIFIC-ION ELECTRODES,
Baltimore Gas and Electric Co., MD.
For primary bibliographic entry see Field 7B.
W87-07293

USE OF ON-LINE ATOMIC ABSORPTION IN A POWER PLANT ENVIRONMENT,
Westinghouse Research and Development Center, Pittsburgh, PA.
For primary bibliographic entry see Field 7B.
W87-07294

ZERO: THE UNREACHABLE GOAL,
Puricons, Inc., Berwyn, PA.
S. A. Fisher.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 167-174, 5 tab, 7 ref.

Descriptors: *Water quality control, *Water sampling, Performance evaluation, Conductivity, Monitoring, Industrial water.

A review of the progress that has been made in improving the quality of high-purity water during the 40 plus years of existence of ASTM Committee D-19 on Water shows that the steps downward in impurity levels are impressive but the goal of zero impurities is still a long way off. The limits of the use of electrical conductivity as the sole monitor of further improvement in industrial water quality have been reached. If still lower impurity levels are sought, their precise nature must be elucidated,

and they must be monitored as specific entities. (See W87-07279) (Author's abstract)
W87-07295

CONTINUOUS CONDUCTIVITY MONITORING OF ANIONS IN HIGH-PURITY WATER,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W87-07297

DESCRIPTION AND EVALUATION OF A CONTINUOUS SAMPLE WATER EVAPORATOR,
Babcock and Wilcox Co., Alliance, OH. Alliance Research Center.
For primary bibliographic entry see Field 7B.
W87-07298

TOXICOLOGY OF NATURAL AND MAN-MADE TOXICANTS IN DRINKING WATER,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W87-07309

MUTAGENIC PROPERTIES OF DRINKING WATER DISINFECTANTS AND BY-PRODUCTS,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W87-07311

ACHIEVING SUCCESS IN COMMUNITY WATER SUPPLY AND SANITATION PROJECTS.
World Health Organization, New Delhi (India). Regional Office for South-East Asia.
For primary bibliographic entry see Field 6B.
W87-07363

ASTM POWER PLANT WATER ANALYSIS MANUAL.
American Society for Testing and Materials, Philadelphia, PA. Committee D-19 on Water.
For primary bibliographic entry see Field 5A.
W87-07419

ECONOMIC EVALUATION OF CONSERVATION CONCEPTS FOR MUNICIPAL WATER SUPPLY SYSTEMS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 3D.
W87-07421

ELECTRICAL CURRENT SENSITIVITY OF GROWING/FINISHING SWINE FOR DRINKING,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W87-07464

EVALUATION OF FACTORS AFFECTING PERFORMANCE OF DIRECT FILTRATION,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
M. R. Collins, G. L. Amy, and C. W. Bryant.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 330-344, April 1987. 2 fig, 6 tab, 30 ref.

Descriptors: *Direct filtration, *Water treatment, Alum, Performance evaluation, Water quality, Filtration, Coagulation, Organic matter, Raw water.

The effects of selected initial conditions and operating parameters on the direct filtration process are evaluated by using a synthetic water/bench-scale apparatus. An orthogonal design of the controlled experimental conditions was used so that the contribution of each controlled variable could be distinguished. The effects of the specific alum doses selected for evaluation on process performance were much greater than the effects of initial water quality conditions or operational/pretreatment parameters. It was found that, when operating near the optimum regions of charge neutralization or aluminum hydroxide precipitation removal mechanisms, the influence of the variables examined was significantly reduced. The results also suggest the existence of a fraction of aquatic organic matter in raw water sources which is not amenable to removal by direct filtration using alum coagulation. (Author's abstract)
W87-07497

REMOVAL OF CADMIUM FROM WATER BY WATER HYACINTH,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-07499

VIRULENCE PLASMID-ASSOCIATED ADHESION OF ESCHERICHIA COLI AND ITS SIGNIFICANCE FOR CHLORINE RESISTANCE,
University Coll., London (England). Dept. of Botany and Microbiology.
S. J. Hicks, and R. J. Rowbury.
Journal of Applied Bacteriology JABAA4, Vol. 61, No. 3, p 209-218, September 1986. 2 fig, 7 tab, 15 ref.

Descriptors: *Adsorption, *Escherichia coli, *Chlorination, *Chlorine resistance, *Plasmids, *Water treatment, Proteins, Temperature effects, Survival, Bacteria, Sewage bacteria, Enteric bacteria, Sand, Agar, Cellulose, Public health, Water quality management, Microbiological studies.

Introduction of the ColV, I-K94 virulence plasmid into strains of Escherichia coli led four out of five strains to a marked increase in the ability to adhere to glass beads. For strain 1829, the plasmid led to increased attachment to other materials including sand, agar, agarose, chitin, and cellulose. The increased adhesion to glass beads was due to the presence of the plasmid and not to its introduction into a variant with altered adhesive properties. The extent of the plasmid-promoted adhesion was greatest for organisms grown at 30-42 C, and adhesion was almost abolished by growth at 21-25 C, a finding in accord with transfer and colicin components being involved in adhesion. Glass bead-attached organisms were used as a model for studying the relevance of attachment to the resistance of E. coli to chlorination during water purification. Bead attached 1829 ColV, I-K94 were more resistant to damage and killing by chlorine than were unattached organisms, suggesting that such chlorine resistance may be significant for survival during water chlorination. Firstly, ColV, I-K94(+) bacteria became attached if incubated in sewage effluent with glass beads at 20 C. Secondly, ColV(+) organisms already attached to glass beads maintained their attachment during 24 hours' incubation in effluent at 20 C. Thirdly, such effluent-incubated organisms remained chlorine-resistant provided that they retained their attachment. (Author's abstract)
W87-07575

WATER UTILITY PROGRAMS FOR THE FUTURE: A WEST TEXAS CITY SOLVES ITS UTILITY PROBLEMS WITH INNOVATIVE USE OF MICROPROCESSOR BASED RADIO TELEMETRY,
F. M. Teagarden, and D. L. Killough.
Southwest and Texas Water Works Journal STWJDV, Vol. 68, No. 9, p 4-6, December 1986. append.

Descriptors: *Measuring instruments, *Water treatment facilities, *Utilities, *Telemetry, *Big Lake, Texas, *Computers, *Monitoring, *Control systems, Automation, Planning, Water supply, Construction, Maintenance, Water conveyance, Pumps.

City officials at Big Lake, Texas have initiated a $750,000 capital improvement program to construct additional water mains and install additional high service water pumps in response to consumer complaints and state agency inspection citations related to low water pressure. A telemetry control and monitoring system was selected for design development. The system, installed by U.S. Alarms of Round Rock, Texas, is composed of five major elements: (1) primary monitoring devices such as flow meter, pressure transmitter, alarm circuits, and phase indicators; (2) remote FM radio transceivers; (3) base FM radio transceiver; (4) microprocessor with CRT and printer; and (5) system software. The system operates automatically according to pre-determined values, but includes a manual override. The basic system has performed virtually flawlessly since November 27, 1985, including during an unanticipated spell of severely cold weather. There has been no major down time. The system is expandable, changeable, and capable of being maintained by local forces. The immediate expandability of the system includes the municipal gas system and the wastewater treatment plant, and has already resulted in improved operation, cost reduction, and avoidance of major problems. (Doria-PTT)
W87-07583

5G. Water Quality Control

RAPID METHODS FOR DETERMINING NUTRIENTS IN LIVESTOCK MANURES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
G. M. Chescheir, P. W. Westerman, and L. M. Safley.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1817-1824, November-December 1985. 7 fig, 6 tab, 32 ref.

Descriptors: *Nitrogen Meter, *Measuring instruments, *Nutrients, *Animal wastes, *Analytical methods, Hydrometers, Land disposal, Estimating, Manures.

Rapid methods for determining major nutrients in livestock manures, mainly swine and dairy stored slurries, were evaluated for accuracy and possible on-farm use. Methods were: (a) correlation of nutrients with specific gravity (measured with a soil hydrometer), (b) ammonia electrode, (c) water analysis field kits, and (d) a 'Nitrogen Meter' that measures nitrogen gas pressure in a reaction chamber. Results from the rapid methods were compared to results from standard laboratory procedures. These rapid methods should not replace periodic laboratory analysis by approved standard methods, but they can be used to improve accuracy of land application rates by providing a rapid indication of changes in manure slurries as a storage facility is unloaded and by providing a good estimate of some nutrients when laboratory analysis is not possible. (Author's abstract)
W87-06644

EFFECTIVENESS OF ALUM IN A WEEDY, SHALLOW LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, C. L. DeGasperi, and D. E. Spyridakis.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 921-926, December 1986. 5 fig, 2 tab, 17 ref.

Descriptors: *Phosphorus removal, *Limnology, *Water pollution treatment, *Alum, *Long Lake, Algae, Species composition, Transparency, Sediments, Lakes, Anoxia, Iron.

An alum treatment in Long Lake (mean depth, 2 m) in 1980 has been effective at controlling internal loading of phosphorus for four years. The fifth summer after treatment, the lake returned to its pre-treatment state. Lake P content decreased from a summer average of 65 microgram(ug)/L during 1976-1978 to about 30 ug/L during four years following treatment. In 1985, summer P content was 61 ug/L. Algal abundance, species composition, and transparency have responded proportionately with P. Alum effectiveness apparently declined because the floc layer tended to sink and become dispersed at a deeper level in the sediment, as well as become covered with new, P-rich sediment. Iron-reduction may be the principal mechanism for internal P loading, although the lake is

unstratified and anoxia is usually not pronounced. (Author's abstract)
W87-06685

NUTRIENT LOADS TO WISCONSIN LAKES: PART II. RELATIVE IMPORTANCE OF NUTRIENT SOURCES,
Rensselaer Polytechnic Inst., Troy, NY.
For primary bibliographic entry see Field 5B.
W87-06691

STORM SEWER DESIGN SENSITIVITY ANALYSIS USING ILSD-2 MODEL,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W87-06716

TRAINING PANELISTS FOR THE FLAVOR PROFILE ANALYSIS METHOD,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. H. M. Bartels, B. M. Brady, and I. H. M. Suffet.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 1, p 26-32, January 1987. 3 tab, 24 ref.

Descriptors: *Drinking water, *Organoleptic properties, *Pollutant identification, *Flavor Profile Analysis Method, *Water flavor, *Water quality, *Water quality control, *Testing procedures, Potable water, Water analysis, Water properties, Quality control, Odor, Tastes.

The drinking water industry needs a standard method for determining the aesthetic quality of water. Currently, only sensory analysis provides the necessary information in the flavor and aroma of drinking water. The flavor profile analysis (FPA) method, as conducted at several water utilities, has provided reproducible results on both the intensity and description of flavor and aroma. After a short training period, a panel can help provide organoleptic information for the water utility manager. The selection and initial training of panelists is an important aspect that must be considered if a panel is to provide reliable information. A general introduction about panel training in the FPA method is presented. (Author's abstract)
W87-06765

DREDGING TO REDUCE ASBESTOS CONCENTRATIONS IN THE CALIFORNIA AQUEDUCT,
California Dept. of Health Services, Sacramento. Toxics Div.
J. Jones, and M. J. McGuire.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 30-37, February 1987. 5 fig, 3 tab, 9 ref.

Descriptors: *Water pollution control, *Dredging, *Asbestos, *Aqueducts, *Water quality control, *Sediments, Water quality, California, Quality control, Floodwater, Drainage area, Hazardous materials, Pollutants, Path of pollutants.

Floodwater draining areas with serpentine deposits in the California Coast Range near Coalinga have carried sediment containing chrysotile asbestos in concentrations of up to 2.6% by weight into the California Aqueduct. The state of California Department of Water Resources used commercially available equipment to dredge the asbestos-laden sediment from a 10 mile (16 kilometer) portion of the aqueduct to determine whether removal of the sediment is a feasible means of controlling concentrations of asbestos in the water. It was found that thorough dredging essentially eliminated the resuspension of asbestos fibers in water flowing through the dredged reach of the aqueduct, and asbestos concentrations in the dredged reach were not statistically different from the upstream background levels. Dredging to control asbestos makes a significant difference to water quality for the small domestic water systems that are supplied by the California Aqueduct. (Author's abstract)
W87-06773

PROTECTION OF WATERLINES TRAVERSING A HAZARDOUS WASTE LANDFILL,
Toledo Public Utilities Dept., OH.
T. L. Kovacik, D. M. Moline, and P. F. Munn.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 38-44, February 1987. 5 fig, 2 tab, 8 ref.

Descriptors: *Landfills, *Hazardous materials, *Groundwater pollution, *Wastes, *Pipelines, *Water quality control, *Design criteria, *Water quality, *Groundwater, Toledo, Ohio, Waste dumps, Waste disposal, Clays, Pollutants, Path of pollutants, Safety, Security agreements, Contamination.

Water plant intake lines for the city of Toledo, Ohio, pass through a privately operated hazardous waste disposal site. Safeguards were negotiated with the operators of the disposal site to protect the intake lines from possible contamination. The described waterline security agreement was accomplished outside regulatory processes since there were no specific federal, state or local regulations covering the situation. The agreement with the landfill operators includes design requirements and safeguards that provide for an estimated 60 to 6000 years of advance warning of contamination, based on the range of clay permeability, if an unlikely leak travels toward the easement from the hazardous waste storage cells. (Author's abstract)
W87-06774

EFFECTS OF SHORT-TERM CHANGES IN WATER QUALITY ON COPPER AND ZINC CORROSION RATES,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
A. Stone, D. Spyridakis, M. Benjamin, J. Ferguson, and S. Reiber.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 2, p 75-82, February 1987. 12 fig, 3 tab, 5 ref. EPA Cooperative agreement CR-810508-02-3.

Descriptors: *Water quality, *Water quality control, *Corrosion, *Copper, *Zinc, *Plumbing, *Pipelines, Pipes, Linear polarization technique, Temperature effects, Temperature, Hydrogen ion concentration, Dissolved oxygen, Residual chlorine, Flow, Conductivity, Mathematical equations, Chemical reactions, Seattle, Washington.

Because of the significant corrosion of household plumbing experienced in Seattle, Washington over the past ten years, the causes of the corrosion were examined. The linear polarization technique was used to evaluate changes in corrosion rates of copper and zinc surfaces in response to short-term changes in water quality. This analytical technique can be applied wherever uniform corrosion, as opposed to pitting, is occurring. The parameters investigated included temperature, pH, dissolved oxygen, chlorine residues, flow, and conductivity. All the parameters except flow rate affected copper corrosion rates. Conductivity, dissolved oxygen, chlorine residues, and temperature affected zinc corrosion rates. Reproducible corrosion rates were obtained within a few minutes of the changes in water quality. (See also W87-06778) (Wood-PTT)
W87-06779

TO QUENCH OUR THIRST: THE PRESENT AND FUTURE STATUS OF FRESHWATER RESOURCES OF THE UNITED STATES,
Oklahoma State Univ., Stillwater. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 6D.
W87-06849

GROUNDWATER CONTAMINATION AND RECLAMATION.
American Water Resources Association, Bethesda, MD.
For primary bibliographic entry see Field 2F.
W87-06850

FIVE-YEAR WATER QUALITY STUDY AT KENNECOTT'S BINGHAM CANYON MINE,
Kennecott, Salt Lake City, UT.
For primary bibliographic entry see Field 4C.
W87-06851

FENCE LAKE COAL PROJECT, GROUNDWATER MONITORING,
Dames and Moore, Phoenix, AZ.
For primary bibliographic entry see Field 5B.
W87-06853

USING CANCER RISK ASSESSMENTS TO DETERMINE 'HOW CLEAN IS CLEAN',
Twitty, Sievwright and Mills, Phoenix, AZ.
R. K. Ferland.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 73-79, 33 ref.

Descriptors: *Water quality standards, *Water quality control, *Groundwater quality, *Standards, *Cancer, *Risk assessment, Drinking water, Public health, Groundwater pollution.

Standards for drinking water, air and water quality and groundwater reclamation are increasingly based on cancer risk assessment calculations. This paper examines the techniques used in cancer risk assessments, the accuracy and issues raised by those techniques and suggests some improvements in the cancer risk assessment process and the manner that process is used in environmental standard-setting. Specifically discussed are the problems encountered in determining the risk of cancer to man posed by various substances on the basis of animal tests and the issues raised by converting animal test results to human risk assessments. From this analysis, the paper discusses what are termed the three 'articles of faith' of cancer risk assessment and the consequences of basin environmental standard-setting on those articles. These articles are: (1) the application of cancer risk assessment to environmental standard-setting results in standards that accurately reflect the variability of risk posed by particular chemicals; (2) the risk assessment process results in more objective standard-setting because it separates the scientific determinations necessary for the risk assessment calculation from the public policy determinations necessary for actually setting standards based upon what are considered 'acceptable risks'; and (3) since risk assessment-based environmental standards can prevent cancer, government officials responsible for protection of the public health must utilize risk assessment results in standard-setting. (See W87-06850) (Lantz-PTT)
W87-06859

CITY/SUBURB VIEWS ON GROUNDWATER ISSUES,
Appalachian State Univ., Boone, NC. Dept. of Political Science.
D. L. Soden, N. P. Lovrich, and J. C. Pierce.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 81-86, 2 tab, 13 ref.

Descriptors: *Public policy, *Groundwater quality, *Water quality control, *Spokane-Rathdrum Prairie Aquifer, Environmental effects, Urban areas, Rural areas, Sewers.

The relationship between public attitudes toward environmental preservation and policy preferences concerning the need to protect the Spokane-Rathdrum Prairie Aquifer (a 'common' resource) from further degradation was examined. Three general areas are addressed. First, policy preferences relevant to groundwater issues are compared across city and suburban samples. Second, city and suburban residents' environmental orientations are contrasted. Finally, the impact of environmental orientations on public policy preferences is analyzed within the urban and suburban samples. Generally, the results suggest that city residents are more concerned about the issue of groundwater pollu-

tion (and the need for a sewer system) in the suburbs than are the residents of the suburbs themselves - stemming from the fact that suburbanites must bear the major portion of the costs of household conversion from septic systems. More importantly, however, preservationist attitudes are strongly enough situated in the belief systems of citizens to support a 'willingness to bear disproportionate burdens' to protect a common metropolitan natural resource. These findings indicate that the distribution of preservationist sentiments across a metropolitan area constitutes an important dimension of policy determination. (See also W87-06850) (Author's abstract)
W87-06860

POLITICS OF GROUND WATER PROTECTION,
National Association of Conservation Districts, Washington, DC.
W. J. Horvath.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 87-93, append.

Descriptors: *Legislation, *Groundwater quality, *Water quality control, *Environmental protection, *Wisconsin, Political aspects, Groundwater pollution, Water pollution control, Aldicarb, Nitrates.

In 1982, the Legislature identified that Wisconsin was experiencing groundwater contamination levels requiring remedial action. The Legislature, as it often does with complex issues, created a legislature study committee composed of legislators, professionals and interested public. The study recognized that this society is a chemical society and it recommended passage of a bill that would: (1) Provide compensation for any well rendered unusable as a result of contamination; (2) Establish a framework for the development and implementation of groundwater protection standards for substances detected in, or with the potential to enter, the groundwater resources of the state; (3) Create a groundwater coordinating council to assist state agencies and facilitate agency and legislative action; and (4) Make a number of minor, but substantive, changes in groundwater regulation. The final bill drafted was a concensus bill representing the best deal everyone could cut. It was fashioned in a six-hour Environmental Resources Committee session and 11-1/2 hours of debate on the Assembly floor, and evoked some 90 amendments. What emerged was an act that charges potential polluters, but recognizes that pollution will occur, and sets up administrative and legal remedies to deal with it. The billwas signed into law May 10, 1984, with partial vetoes by the Governor. (See alsoW87-06850) (Lantz-PTT)
W87-06861

BISCAYNE AQUIFER PROTECTION PLAN,
CH2M Hill, Inc., Gainesville, FL.
U. P. Singh, J. E. Orban, and A. L. Docal.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 97-103, 2 fig, 1 tab, 7 ref.

Descriptors: *Water quality control, *Biscayne Aquifer, *Groundwater quality, *Florida, Aquifers, Drinking water, Municipal wells, Regulations, Waste management, Water pollution control, Groundwater pollution.

The Biscayne Aquifer is the sole source of drinking water for approximately 3 million residents of southeast Florida. Several hazardous waste sites overlie the aquifer, and low to moderate levels of several toxic contaminants have been detected in the groundwater in many areas. Many municipal well fields have been contaminated with priority pollutants, and some of them have been shut down. Remedial actions have been recommended for specific sites. A preventive action plan for protecting the Biscayne Aquifer from hazardous waste contamination was developed and recommended for the tri-county Biscayne Aquifer area (Dade, Broward, and Palm Beach Counties). The 20 elements of this plan generally fit into the following categories: (1) regulation, (2) waste management, (3) construction/treatment, and (4) information needs. The plan is designed for implementation at the local (County) level to supplement existing state and federal regulations. The recommendations of the protection plan were prioritized and divided into three phases. Implementation of this plan will help reverse the trend of continuing groundwater pollution in southeast Florida. (See also W87-06850) (Author's abstract)
W87-06862

GROUNDWATER PROTECTION BY SOIL MODIFICATION,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
R. B. Thurman, and C. P. Gerba.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 105-108, 2 fig, 3 tab, 27 ref.

Descriptors: *Water quality control, *Soil water, *Groundwater quality, Sewage effluents, Bacteria, Viruses, Aluminum, Water pollution control, Water pollution treatment, Flooding.

Certain soils exhibit a limited capacity for removal of microbes when domestic sewage effluent percolates through the soil. In this study metallic aluminum was added to soil in an attempt to enhance the removal of viruses. Water and sewage containing the bacterial virus MS-2 virus was passed through 20-cm columns of sandy soil to which 5.0 gm of aluminum was added. The soil columns were flooded in cycles of 7 days flooding and 3 days drying. Modification of the soil by addition of metallic aluminum caused a six to eight log decrease in virus concentrations, while control columns with no aluminum showed only a two log decrease. Virus reduction continued in the test columns, with no significant changes, after five weeks of intermittent flooding. (See also W87-06850) (Author's abstract)
W87-06863

PREVENTING VIRAL CONTAMINATION OF DRINKING WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
M. V. Yates, S. R. Yates, A. W. Warrick, and C. P. Gerba.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 117-121, 5 fig, 1 tab, 12 ref.

Descriptors: *Water quality control, *Drinking water, *Groundwater quality, *Viruses, *Tucson, *Arizona, Groundwater pollution, Statistical analysis, Groundwater movement, Septic tanks, Water supply.

Enteric viruses are believed responsible for as much as 65% of waterborne disease outbreaks in the U.S., the majority of which are due to the use of contaminated groundwater. The purpose of this study was to predict zones of protection around drinking water wells in an effort to limit groundwater contamination from viruses. Seventy-one water samples were collected from wells in the Tucson basin. The samples were inoculated with MS-2 phage and the decay rates of the virus with time were determined. Kriging, a geostatistical method which analyzes data based on its spatial arrangement, was employed to estimate decay rates at point for which no samples were taken using known values obtained at nearby wells. Using the kriged values for virus decay rates and the characteristics of groundwater flow in the Tucson basin, a map of the area was constructed which delineates zones around drinking water wells within which potential sources of groundwater pollution should not be placed to ensure the absence of viruses in the wells. (See also W87-06850) (Author's abstract)
W87-06865

RAPID REMOVAL OF A GROUNDWATER CONTAMINANT PLUME,
Geological Survey, Menlo Park, CA.
L. J. Lefkoff, and S. M. Gorelick.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 125-131, 5 fig, 8 ref.

Descriptors: *Water quality control, *Groundwater pollution, *Contamination, *Plumes, *Aquifer restoration, *Water pollution treatment, Pumping, Model studies, Groundwater movement, Cost analysis.

Attempts to restore an aquifer within a short time period may be severely constrained by hydrologic conditions. Rapid restoration is associated with high groundwater velocities, steep cones of depression, large pumping lifts, and high pumping rates. Pumping costs may increase dramatically with the desired speed of restoration. A groundwater management model is used to design an aquifer restoration system that removes a contaminant plume from a hypothetical aquifer in four years. The design model utilizes groundwater flow simulation and mathematical optimization. Optimal pumping and injection strategies achieve rapid restoration for a minimum total pumping cost. Rapid restoration is accomplished by maintaining specified groundwater velocities around the plume perimeter toward a group of pumping wells located near the plume center. The model does not account for hydrodynamic dispersion. Results show that pumping costs are particularly sensitive to injection capacity. An 8% decrease in the maximum allowable injection rate maylead to a 29% increase in total pumping costs. (See also W87-06850) (Author's abstract)
W87-06866

STRATIGRAPHIC INFLUENCE ON CLEAN-UP METHODS: A CASE HISTORY,
Dames and Moore, San Francisco, CA.
J. E. Donovan, and W. A. Murray.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 133-139, 5 fig, 1 tab.

Descriptors: *Cleanup operations, *Stratigraphy, *Case studies, *Groundwater pollution, *Path of pollutants, Solvent transport, Leakage, Water pollution prevention, Pumping, Organic solvents.

To be effective, cleanup methods for subsurface organic solvent contamination must be designed for site-specific soil and groundwater conditions. At the site under investigation, a leaking buried tank containing waste solvents was excavated in April 1981. Groundwater occurs between depths of 25-30 feet within low permeability deposits, and an effluent creek is located 200 feet down-gradient of the leak. During site characterization, a 3-6 ft thick clay layer was identified five feet below the water table in the plume area. Chemical test results showed that this clay layer substantially retarded downward solvent migration, and that most of the percolation from the unsaturated soils into groundwater had already occurred. Therefore, the primary cleanup objective was to prevent lateral solvent migration down-gradient to the creek within the thin groundwater unit above the confining clay layer. After consideration of more costly alternatives, the standard 'pump and treat' approach was modified to accomodate the low permeability and very thin nature of the contaminated zone. Solvent concentrations were reduced prior to surface discharge by wet impingement scrubber treatment. A cone depression large enough to contain the plume was developed after six months of continuous pumping. Monitoring results demonstrate that solvent concentrations in groundwater were significantly reduced by three years of cleanup operations. (See also W87-06850) (Author's abstract)
W87-06867

NEUTRALIZATION OF ACIDIC GROUND WATER NEAR GLOBE, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
J. H. Eychaner, and K. G. Stollenwerk.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 141-148, 1 fig, 3 tab, 15 ref.

Descriptors: Groundwater pollution, *Water pollution treatment, *Globe, *Arizona, *Neutralization, Iron, Copper, Dissolved solids, Hydrogen ion concentration, Aquifers, Chemical reactions, Heavy metals.

Highly acidic contaminated water is moving through a shallow aquifer and interacting with streams near Globe, Arizona. Dissolved concentrations reach 3,000 mg/L iron, 150 mg/L copper, and 16,400 mg/L total dissolved solids; pH is as low as 3.6. The contaminated plume is about 17 km long and 600 m wide. Adjacent uncontaminated water has neutral pH, as little as 400 mg/L total solutes, and trace concentrations of metals. The aquifer consists of alluvium and conglomerate derived from granite, schist, granite porphyry, and volcanics. Sediment size ranges from clay to boulders, and calcareous cement content increases with the age of sediment. The aquifer discharges about 0.3 cu m/s to a perennial stream. Samples from 16 PVC-cased observation wells include uncontaminated, contaminated, transition, and neutralized waters. Chemical reaction with sediments and mixing with uncontaminated water neutralizes the acidic water. The reactions form a transition zone where gypsum replaces calcite and most metals precipitate. Ferric hydroxide also precipitates if sufficient oxygen is available. Abundant gypsum crystals and ferric hydroxide coatings have been recovered from well cuttings. Large sulfate concentrations produce sulfate complexes with many metals that inhibit removal of metals from solution. (See also W87-06850) (Author's abstract)
W87-06868

AQUIFER RESTORATION: IN SITU TREATMENT AND REMOVAL OF ORGANIC AND INORGANIC COMPOUNDS,
Groundwater Technology, Inc., Chadds Ford, PA.
P. M. Yaniga, and W. Smith.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 149-165, 10 fig, 11 ref.

Descriptors: *Aquifer restoration, *Water pollution treatment, *Organic compounds, *Inorganic compounds, *Groundwater pollution, Hydrocarbons, Biological treatment, Chemical treatment, Biodegradation, Plumes, Dissolved oxygen.

Subsurface contamination from hydrocarbons predominantly exists in the three phases of free floating or mobile hydrocarbons, product adsorbed onto the soil matrix, and hydrocarbons dissolved in the aqueous environment. The latter two phases of adsorbed and dissolved hydrocarbon contamination affect a greater area within the formation. The symptomatic impacts, although less intense than free product, are more persistent. Discussed here is a three-year abatement program implemented to address hydrocarbons adsorbed/dissolved into the groundwater system. The treatment program consisted of a combined physico/chemico/biodegradation approach to reduce aquifer degradation and supply interim potable water to the impacted well owners. The in situ biodegradation phase consisted of: (1) introduction of clean oxygenated water from beyond the contaminant plume, (2) addition of dissolved oxygen by mechanical air spargers, (3) utilization of hydrogen peroxide for the dissolved oxygen and subsequent phase out of air spargers, and (4) addition of nutrients at prescribed doses and intervals. The net results of the work program are a 70-80% reduction of total hydrocarbons within the aquifer. (See also W87-06850) (Lantz-PTT)
W87-06869

SHALLOW-AQUIFER DEWATERING FOR SOURCE-AREA CONTROL,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
J. M. Farr, G. B. Matanga, and F. R. McLaren.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 167-174, 5 fig, 1 tab, 6 ref.

Descriptors: *Dewatering, *Water pollution control, *Groundwater pollution, *Aquifers, Mathematical models, *Flow profiles, Water pollution treatment, Wells.

Remedial measures for contaminated groundwater often involve operations to dewater portions of an unconfined (water table) aquifer. Well field design for efficient dewatering of an unconfined aquifer is complicated by the lack of exact analytical solutions to the governing nonlinear flow equations. Because of the difficulties associated with nonlinearity and moving boundary effects near extraction wells in an unconfined aquifer and because of the need to account for a variety of hydrogeologic field conditions, numerical modeling can be very useful. Described is an application of the USGS McDonald/Harbaugh 3-dimensional finite difference groundwater modeling code to aid in well field design for unconfined and anisotropic conditions with partially penetrating wells. Techniques for handling boundary conditions at the extraction wells are given as part of a systematic modeling approach to this dewatering problem. (See also W87-06850) (Author's abstract)
W87-06870

ANALYSIS OF WATERS ASSOCIATED WITH ALTERNATIVE FUEL PRODUCTION.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5A.
W87-06871

EVALUATION OF UTILITY WASTES FOR HAZARDOUS WASTE POTENTIAL,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
D. W. Weeter, and H. L. Phillips.
IN: Analysis of Waters Associated with Alternative Fuel Production, A Symposium sponsored by ASTM Committee D-19 on Water, Pittsburgh, PA, June 4-5, 1979. 1981. p 95-100, 4 tab, 6 ref.

Descriptors: *Leachates, *Hazardous wastes, *Water quality control, *Waste disposal, *Heavy metals, *Path of pollutants, Fixation, Leachates, Complexation Comparison studies.

Recently, it has been recognized that coal ashes and scrubber sludges contain a variety of materials, which, if released in soluble form from a disposal area, could be damaging to the quality of surface and subsurface water. The Resource Conservation and Recovery Act of 1976 (RCRA) places these wastes in a special category. Stringent controls will be placed upon their disposal in the future unless it can be shown that hazardous materials, such as heavy metals, will not leach from disposal areas. Fixation is one potential means of limiting the release of materials. Two toxicant extraction procedures and agitation with unbuffered deionized water were compared on the basis of heavy metal concentrations of the leachate when these treatments were applied to a fixed (crushed and uncrushed) and unfixed dry additive scrubber waste. Comparison of the methods indicates that the buffering capacity of a waste, as well as its physical structure, determines the magnitude of heavy metals release. It was found that while fixation may reduce the permeability and surface area-to-volume ratio of a waste, the pH-solubility phenomenon is a controlling factor in some cases for the concentration of metals in simulated leachates. (See also W87-06871) (Author's abstract)
W87-06880

WATER FOR SUBSURFACE INJECTION.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W87-06888

ELECTROCHEMICAL HYDROGEN PATCH PROBE CORRELATED TO CORROSION RATE IN A SLIGHTLY SOUR WATER FLOOD,
Petrolite Instruments, Houston, TX.
For primary bibliographic entry see Field 7B.
W87-06890

CHARACTERIZATION OF UNSTABLE WATERS BY SEEDED CRYSTAL GROWTH TECHNIQUES,
Occidental Research Corp., Irvine, CA.
S.-T. Liu, and D. W. Griffiths.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 23-33, 9 fig, 1 tab, 11 ref.

Descriptors: *Inhibition, *Analytical methods, *Seeded crystal growth, *Industrial water, *Crystallization, Crystallography, Oil fields, Water quality, Injection water, Process water, Deposition.

The seeded crystal growth experiment was examined as to its applicability for investigating the growth and inhibition of waterborne deposits. Basic and practical aspects of the experiment are reviewed, and examples are cited to demonstrate experimental capabilities. In one of the examples, it is shown that the experiment can be conducted in a natural oil field brine to resolve small differences in inhibitor performance. It is concluded that the seeded crystal growth experiment is the best available procedure for characterizing unstable waters where reproducibility and reliability are of major importance. (See also W87-06888) (Author's abstract)
W87-06891

ION-EXCHANGE SOFTENING OF HIGH-SOLIDS WATERS,
Diamond Shamrock Corp., Redwood City, CA.
R. E. Anderson.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 128-142, 9 fig, 2 tab, 6 ref.

Descriptors: *Water treatment, *Water softening, *Ion exchange, *Water quality, *High-solids waters, *Sodium, *Hardness, Resins, Brines.

Extensions of conventional sodium-cycle softening to high-solids waters is restricted by the fundamental properties of ion exchange systems. Resin performance is a function of water composition, both in regard to total dissolved salts and the fraction of hardness salts. Volume treated to hardness breakthrough, and hardness leakage can be estimated with a useful degree of accuracy by use of equilibrium relationships. Adjustment of performance for different levels of regeneration can be made by use of empirical data relating degree of regeneration to salt dosage. Waters with total dissolved solids above 5000 ppm can be softened by use of weak acid resins in many cases. Depending on the nature of the salts present, a weak acid resin may be used in either a sodium or hydrogen cycle. Although acid and base are required for regeneration, chemical costs are competitive with conventional softening in many situations. Softening of saturated brines requires use of chelating resins showing high selectivity for hardness ions over sodium ion. (See also W87-06888) (Author's abstract)
W87-06898

LOW-COST WATER SUPPLY AND SANITATION TECHNOLOGY: POLLUTION AND HEALTH PROBLEMS.
World Health Organization, New Delhi (India). Regional Office for South-East Asia.
For primary bibliographic entry see Field 5D.
W87-06937

ASSESSMENT OF TRACE GROUND WATER CONTAMINANTS RELEASE FROM SOUTH TEXAS IN-SITU URANIUM SOLUTION MINING SITES,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06940

STREAMLINE-CONCENTRATION BALANCE MODEL FOR IN-SITU URANIUM LEACHING AND SITE RESTORATION,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 5B.
W87-06944

USE OF COMPUTERS IN WATER SUPPLY REGULATION,
Michigan Dept. of Public Health, Lansing. Div. of Water Supply.
For primary bibliographic entry see Field 7C.
W87-06968

AUTOMATION OF THE WATER AND SEWER BILLING PROCESS,
Genesee County Water and Waste Services, FLint, MI.
For primary bibliographic entry see Field 6C.
W87-06972

UTILITY RATE STUDIES - DEVELOPMENT OF USER CHARGE SYSTEMS,
Camp, Dresser and McKee, Inc., Detroit, MI.
For primary bibliographic entry see Field 6C.
W87-06973

DREDGED-MATERIAL DISPOSAL IN THE OCEAN.
For primary bibliographic entry see Field 5E.
W87-06979

DREDGED-MATERIAL OCEAN DUMPING: PERSPECTIVES ON LEGAL AND ENVIRONMENTAL IMPACTS,
National Wildlife Federation, Washington, DC.
For primary bibliographic entry see Field 5E.
W87-06981

TECHNICAL IMPLEMENTATION OF THE REGULATIONS GOVERNING OCEAN DISPOSAL OF DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
R. K. Peddicord, and J. C. Hansen.
IN: Dredged-Material Disposal in the Ocean, Wastes in the Ocean, Volume 2. John Wiley and Sons, New York, New York. 1983. p 71-88, 1 fig, 5 tab, 15 ref.

Descriptors: *Sediments, *Regulations, *Waste disposal, *Dredging, *Water pollution effects, *Path of pollutants, *Los Angeles Harbor, Bioaccumulation, Bioassay, Cadmium, Copper, Lead, Mercury, Silver, Zinc, Polychlorinated biphenyls, Quantitative analysis, Heavy metals.

The 11 January 1977 Federal Register cited criteria regulating the ocean disposal of dredged material which require bioassays and bioaccumulation tests on the solid phase of dredged material as part of an environmental evaluation. An application for an ocean disposal permit for maintenance dredging in Los Angeles Harbor was evaluated under the criteria. Solid-phase bioassays of Acanthomysis sculpta, Neanthes arenaceodentata and Macoma nasuta showed no statistically significant mortality due to dredged material. Bioaccumulation studies of Cd, Cu, Pb, Hg, Ag, Zn, and PCB in M. nasuta showed statistical increases in Cd, Cu, and PCB in clams exposed to some dredged-material samples compared to those in a reference sediment from the vicinity of the disposal site. While the differences were statistically significant, all tissue concentrations were low, and the differences between test and reference animals were small, 0.09 micrograms/gm for Cd, 0.8 micrograms/gm for Cu, and 0.04 micrograms/gm for PCB. Quantitative evaluation of the environmental implications of these increases in tissue contaminant concentrations is difficult to present. Since the criteria require that such evaluations be made, the environmental protection provided by the regulatory program would be enhanced by moreinvolvement from scientists in making these evaluations. (See also W87-06979) (Author's abstract)
W87-06982

STATISTICAL METHODOLOGY FOR PREDICTING SALINITY IN UPPER LAVACA BAY,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-07002

CE-QUAL-W2: A NUMERICAL TWO-DIMENSIONAL, LATERALLY AVERAGED MODEL OF HYDRODYNAMICS AND WATER QUALITY; USER'S MANUAL.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W87-07004

EXPERIMENTAL MANIPULATIONS OF PHYTOPLANKTON IN EAU GALLE RESERVOIR,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W87-07005

HANDBOOK ON RESERVOIR RELEASES FOR FISHERIES AND ENVIRONMENTAL QUALITY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W87-07008

TECHNICAL SUMMARY OF THE A/M AREA GROUNDWATER (AMGW) REMEDIAL ACTION PROGRAM,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
J. L. Steele, and D. E. Gordon.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84013340. Price codes: A03 in paper copy, A01 in microfiche. DOE Report DOE/SR/00001--T24, (1984). 36 p, 14 fig, 8 tab.

Descriptors: *Groundwater pollution, *Path of pollutants, *Water pollution treatment, Groundwater quality, Solvents, Leaking, Storage tanks.

Groundwater in the vicinity of M Area of the Savannah River Plant Facility, was found to be contaminated with metal degreasing solvents. The solvents originated from surface sources such as the M-Area settling basin, sewer pipeline, solvent storage tank, and the tributary to Tims Branch. The spatial extent of the groundwater contamination was defined but not completely characterized. A remedial action program for cleaning up the affected groundwater was proposed. This technical summary contains the basis for and the details of the proposed M-Area groundwater recovery and treatment process. (Lantz-PTT)
W87-07013

LONG-TERM EFFECTIVENESS OF CAPPING IN ISOLATING DUTCH KILLS SEDIMENT FROM BIOTA AND THE OVERLYING WATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. M. Brannon, R. E. Hoeppel, I. Smith, and D. Gunnison.
Available from the National Technical Information Service, Springfield, VA 22161. As ADA 172353. A03-PC in papercopy, A01-MF in microfiche.Miscellaneous Paper EL-86-8, August 1986. Final Report. 22 p, 1 fig, 12 tab, 15 ref, append.

Descriptors: *Path of pollutants, *Dutch Kills sediment, *Waste disposal, *Capping, *Sedimentation, *New York, Dredging, Chemical wastes, Clams, Sediments, Bioaccumulation, Edgewater cap.

At the request of the New York District, the effectiveness of capping in chemically and biologically isolating contaminated dredged material over a 1-year period was investigated using large (250-L) laboratory reactor units. The ability of Edgewater cap material to isolate contaminated Dutch Kills sediment was assessed by following the movement of chemical contaminants and microbial spores contained in the Dutch Kills sediment into the water column and by monitoring the biological uptake of chemical contaminants by the clam, Mercenaria mercenaria. At the conclusion of the year study, sediment cores were obtained from the experimental units and analyzed for chemical contaminants to determine if contaminant movement into the cap had occurred. Results of water column, animal bioaccumulation, and core sampling indicate that capping of contaminated Dutch Kills sediment with either 10 or 50 cm of clean cap material will prevent the movement of detectable amounts of contaminants through the cap material. It is highly likely that the greatest value of a cap is in physically isolating contaminated dredged material from the overlying water and biota. In the absence of bioturbation or physical disturbance, core data revealed that the cap maintained its integrity over the course of a year without mixing with the contaminated sediment. Addition of a 10-cm Edgewater cap, along with a suitable thickness of material to isolate burrowing benthic organisms from the dredged material and prevent current and wave action from removing the cap, should prevent movement of contaminants into the water and biota in the field. (Author's abstract)
W87-07017

SRP GROUNDWATER PROTECTION IMPLEMENTATION PLAN, (DRAFT),
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
J. D. Spencer.
Available from the National Technical Information Service, Springfield, VA 22161, DE84013156, Price codes: A03 in paper copy, A01 in microfiche. DuPont Report No. DPST-83-829-Draft, September 14, 1983. 28 p.

Descriptors: *Savannah River Plant, *Water quality control, *Groundwater quality, *Groundwater protection, *Wastewater treatment, Water pollution control, Monitoring, Chlorocarbons, Industrial wastewater.

Maintaining the quality of the Savannah River Plant environment and protecting offsite areas from the impact of facility operations were recognized as important goals prior to site startup. Monitoring programs were initiated in the Savannah River and on the site to establish baseline conditions before facility operations began. These programs by plant personnel and other scientific groups have been significantly expanded during the 30 years of operation. Monitoring results cover airborne effluents and surface and subsurface waters. Analyses include both radioactive and nonradioactive species. These programs have established the Savannah River site as one of the most extensively monitored locations in the world. In 1981, in response to the Resources Conservation and Recovery Act (RCRA), an expanded program of groundwater monitoring was instituted. Based on the results of this program, further changes in the site's effluent treatment and waste management practices will be required. For example, process wastewater treatment facilities will be incorporated in the M-Area fuel and target fabrication facilities, the F and H-Area chemical separation plants and the TNX pilot scale development facilities. These effluents will be treated to comply with all applicable state and federal regulations, eliminating possible contamination of the groundwater for current and future operations. Management of the groundwater contaminated with chlorocarbons in the site's main administrative area has received high priority attention since the contamination was discovered by site personnel in 1981. Eighty-two

monitoring wells have been drilled, the extent of the contamination defined, and technology for chlorocarbon removal demonstrated. Chlorocarbon removal is currently underway in demonstration air stripper units. Final design is underway for a large scale system which will extract the contaminated water and remove the chlorocarbons. Protection of groundwater from hazardous materials placed in landfills during earlier operations, or from seepage basin activity, will be achieved through a program of expanded groundwater monitoring, removal, and treatment of contaminated materials where needed, and development of decommissioning plans. (Lantz-PTT)
W87-07025

FILTRATION,
For primary bibliographic entry see Field 5F.
W87-07041

DISINFECTION,
For primary bibliographic entry see Field 5F.
W87-07042

TASTE AND ODOR CONTROL,
For primary bibliographic entry see Field 5F.
W87-07044

HYPOLIMNETIC AERATION: FIELD TEST OF THE EMPIRICAL SIZING METHOD,
Ministry of Environment, Vancouver (British Columbia). Fisheries Research and Technical Services Section.
K. I. Ashley, S. Hay, and G. H. Scholten.
Water Research WATRAG, Vol. 21, No. 2, p 223-227, February 1987. 1 fig, 2 tab, 17 ref.

Descriptors: *Hypolimnetic aeration, *Water pollution treatment, *Limnology, *Eutrophic lakes, *Oxygen demand, Comparison studies, Performance evaluation, Design criteria, Aeration, Oxygen, Lakes, Flow, Velocity, Field tests.

A hypolimnetic aeration system was recently installed in a small (16 ha S sub a) eutrophic lake and a comparison made between measured performance and predicted performance from an empirical sizing method. The design variables used to size the system were: hypolimnetic volume 451,600 cu m, maximum hypolimnetic oxygen consumption 0.2 mg/l/d; aerator input rate 2 mg/l; water velocity 0.76 m/s and depth of air release 12.2 m. A 3.7 kW compressor (0.57 cu m/min) generated a water velocity of 0.46 m/s, a water flow of 17.7 cu m/min and a theorectical hypolimnetic circulation period of 18 days. Dissolved oxygen increased by an average of 1.6 mg/l on each cycle through the aerator, and aerator input rates ranged from 0.6 to 2.6 mg/l. Hypolimnetic oxygen consumption averaged 0.12 mg/l/d and ranged between 0.02 and 0.21 mg/l/d. The aeration system was unable to meet the daily oxygen demand (90 kg) as the water velocity was slower than expected (0.46 m/s). To avoid undersizing future aeration installations the following recommendations should be considered when using the empirical sizing formula: (1) estimates of oxygen consumption should be annual maximums from aerobic hypolimnia; (2) aerator input rates should be conservative (e.g. 1-4 mg/l) and increase with depth; (3) water velocity of 0.45-0.50 m/s should initially be used when no information on actual bubble size or velocity is available; (4) aeration start-up should be timed to avoid periods of accumulated oxygen demands. (Author's abstract)
W87-07059

PROPOSAL OF ECOTOXICOLOGICAL CRITERIA FOR THE ASSESSMENT OF THE IMPACT OF POLLUTION ON ENVIRONMENTAL QUALITY,
Paris-11 Univ., Orsay (France).
For primary bibliographic entry see Field 5C.
W87-07072

UK INTERPRETATION AND IMPLEMENTATION OF THE EEC SHELLFISH DIRECTIVE,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
P. Wathern, S. N. Young, I. W. Brown, and D. A. Roberts.
Environmental Management EMNGDC, Vol. 11, No. 1, p 7-12, January 1987. 2 tab, 12 ref.

Descriptors: *Wales, *EEC Shellfish Directive, *Water law, *England, *Public health, *Water quality, Fisheries, Policies.

The EEC Shellfish Directive is a policy designed to protect and, where necessary, improve the quality of designated shellfish waters. Its implementation within the UK, however, has had no effect upon water quality for two reasons. First, the policy has important defects having ambiguities concerning public health provisions and lacking designation criteria. Second, UK government has sought to achieve formal compliance, while at the same time ensuring that its full financial impact on public expenditure has been contained. Consequently, only those fisheries which already comply with water quality standards have been designated. Within Wales, one fishery has been designated, while other, commercially more important, but grossly contaminated shellfisheries have not. (Author's abstract)
W87-07081

COST EFFICIENCY OF TIME-VARYING DISCHARGE PERMIT PROGRAMS FOR WATER QUALITY MANAGEMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. W. Eheart, E. D. Brill, B. L. Lence, J. D. Kilgore, and J. G. Uber.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 245-251, February 1987. 4 fig, 4 tab, 12 ref. NSF Award PRA-81-21692.

Descriptors: *Water quality management, *Economic aspects, *Cost analysis, *Discharge frequency, *Assimilative capacity, *Water pollution control, *Permits, Evaluation, Costs, Social costs, Water quality control, Water pollution, Capacity, Watercourses, Biochemical oxygen demand, Willamette River, Oregon, Mathematical studies, Mathematical equations, Simulation, Simulation analysis.

Dynamic permits programs for water pollution control have the potential for achieving higher water quality at lower social cost by allowing discharge rates that increase and decrease according to changes in the assimilative capacity of the watercourse. Various methods for structuring dynamic permits programs, including transferable permit programs, were examined. Through two studies, the estimated costs of such programs are compared to those of more traditional programs. The first study is a simulation of permit programs for biochemical oxygen demand control for 10 dischargers on the Willamette River in Oregon. The second is a study of seven hypothetical treatment plants using a two-season optimization model. The results of the first study show significant potential cost savings under dynamic permits, while the results of the second, for which the capital options are limited to variations in one type of wastewater treatment process train, show an insignificant improvement in overall cost. (Author's abstract)
W87-07106

GROUNDWATER CONTAMINATION FROM WASTE MANAGEMENT SITES: THE INTERACTION BETWEEN RISK-BASED ENGINEERING DESIGN AND REGULATORY POLICY: 1. METHODOLOGY,
Hart, Crowser and Associates, Inc., Seattle, WA.
For primary bibliographic entry see Field 5E.
W87-07115

GROUNDWATER CONTAMINATION FROM WASTE MANAGEMENT SITES: THE INTERACTION BETWEEN RISK-BASED ENGINEERING DESIGN AND REGULATORY POLICY: 2. RESULTS,
Hart, Crowser and Associates, Inc., Seattle, WA.
For primary bibliographic entry see Field 5E.
W87-07116

STUDY OF AERATION AT WEIRS AND CASCADES,
Maebashi City Coll. of Technology (Japan).
H. Nakasone.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 64-81, February 1987. 15 fig, 1 tab, 30 ref.

Descriptors: *Aeration, *Water pollution treatment, *Weirs, *Water treatment, *Hydraulic design, *Mathematical equations, Flow discharge, Tailwater, Hydraulics, Overland flow, Dissolved oxygen, Hydraulic jump.

Different research workers have pointed out that fall-height, discharge, and tailwater depth are important parameters for weir-aeration. However, except for the equation proposed by the writer, none of the presented equations include these three parameters simultaneously. The validity of the Nakasone equation, based on laboratory tests, was investigated by using measurements from various weirs in the field, notably those on the River Meuse in The Netherlands and on the cascades of the drinking water plant of the city of The Hague. Results are satisfactory and encouraging. Some general conclusions follow. Since aeration efficiency is higher for fall heights smaller than 1.2 m, cascades with heights of no more than 1.2 m are preferred to single falls with greater heights. Aeration efficiency increases with increasing discharge to a certain point and then decreases. The optimal point is around q = 235 cu m/m x h (q is discharge per meter width of weir). Aeration increases with increasing tailwater depth to an optimal limit. (Airone-PTT)
W87-07122

AERATION-INDUCED CIRCULATION FROM LINE SOURCES. I: CHANNEL FLOWS,
Shell Development Co., Houston, TX.
J. Wen, and R. S. Torrest.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 82-98, February 1987. 9 fig, 25 ref. Project A-030-NH.

Descriptors: *Aeration, *Lake restoration, *Water pollution treatment, *Mixing, *Destratification, *Lakes, Water quality, Water treatment, Eutrophication, Mathematical analysis, Surface velocity, Vertical flow, Water circulation.

Aeration and mixing of lakes and reservoirs help to control eutrophication and improve water quality. Overall design is often based on economic constraints or hopefully similar situations, with limited knowledge of circulation effectiveness. However, the nature of the vertical flow of water entrained by air plumes rising from manifolds was studied in detail for other applications and effectively modeled. Here part of the remaining fluid mechanics of aeration-induced circulation is described. Experimental studies of the resulting surface flows supplement and extend previous work. Surface velocity decay is described and the circulation cell size from the manifold is shown to be about four times the water depth. Detailed measurements of velocity profiles are presented for a wide range of aeration rates in channels. The influence of aerator design and depth is illustrated, as is the variation of circulation efficiency with aeration rate. A companion paper presents the corresponding buildup of dissolved oxygen. (See also W87-07124) (Author's abstract)
W87-07123

AERATION-INDUCED CIRCULATION FROM LINE SOURCES. II: DISSOLVED OXYGEN VARIATIONS,
Shell Development Co., Houston, TX.
J. Wen, and R. S. Torrest.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 99-105, February 1987. 5 fig, 11 ref.

Descriptors: *Aeration, *Lake restoration, *Water pollution treatment, *Lakes, *Dissolved oxygen, *Water treatment, *Mixing, Water circulation, Eutrophication, Wastewater treatment, Vertical flow.

Dissolved oxygen buildup from aeration manifolds in a laboratory channel is shown to be uniform with vertical and lateral position in the primary circulation cell which extends to four times the depth. The influence of aeration rate on the rate of dissolved oxygen buildup is shown to follow a simple first-order model, whose time constant varies with aeration rate per unit length to the minus 0.8 power for each of three different manifolds. While the details of manifold design are important for oxygen transfer, they have little influence on the circulation except at very low rates. When combined with the detailed flow measurements presented separately these dissolved oxygen buildup results provide a more complete picture of line source aeration than is available from previous studies. (See also W87-07123) (Author's abstract)
W87-07124

CALCIUM CARBONATE PRECIPITATION AND TRANSPARENCY IN LAKES: A CASE STUDY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, H. Greer, M. G. Perkins, S. D. Field, and E. Mills.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 124-133, February 1987. 6 fig, 2 tab, 24 ref.

Descriptors: *Transparency, *Calcium carbonate, *Lakes, *Precipitation, *Lake restoration, *Lake reclamation, *Water pollution treatment, *Lake rehabilitation Turbidity, Owasco Lake, Phosphorus, Water quality, Water management, Secchi disks, Public opinion.

The major role the whiting phenomenon (precipitation of calcium carbonate) played in regulating transparency in hard water Owasco Lake, New York, during the summer of 1985 is documented. Two whiting events occurred that could have easily been mistaken by the public as phytoplankton blooms. Whiting explained more of the variability observed in Secchi disk transparency (SD) than phytoplankton pigments. SD would have been approximately 65% greater during the summer of 1985 in the absence of whiting. The failure of SD to increase since the early 1970's, despite a major reduction in the concentration of phytoplankton is probably due to a recurring prominent role of whiting in attenuating light in the lake. These charactersitics are considered potentially widely occurring in hard water lakes, as the whiting phenomenon is common in these systems. Management programs for hard-water lakes focusing on improved transparency should be aware of the potential for interference from whiting. (Author's abstract)
W87-07125

WATER QUALITY DATA ANALYSIS IN CHUNG KANG RIVER,
Asian Development Bank, Manila (Philippines).
For primary bibliographic entry see Field 5B.
W87-07130

USE OF COMMERCIAL ACRYLONITRILE STANDARD FOR WASTEWATER ANALYSIS,
Professional Analtyical and Consulting Services, Inc., Coraopolis, PA.
For primary bibliographic entry see Field 5A.
W87-07147

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART II-BIOLOGICAL PROCESS CONTROL,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
M. S. Finstein, F. C. Miller, J. A. Hogan, and P. F. Strom.
Biocycle BCYCDK, Vol. 28, No. 2, p 42-47, February 1987. 46 ref.

Descriptors: *Regulations, *Environmental Protection Agency, *Composting, *Ventilation, *Publications, *Temperature control, Sludge, Biological treatment, Bacteria, Process control, Performance evaluation.

EPA technical guidance on composting wastewater sludge lacks appreciation of the effect of temperature on the resident microbial community and on resultant performance. Quoted material from the four most recent guidance publications are used to illustrate this, accompanied by commentary by the authors. The uses of ventilation, oxygen concentration, heat and moisture removal, and temperature control are discussed. EPA's evaluation of the performance of three facilities (Western Branch, Dickerson, and Silver Spring 'Site II', all in Maryland) forms a major part of one publication, and this report is analyzed by the authors. The Rutgers Strategy (also described in the article) is a biologically oriented approach to process control which matches ventilative heat removal to its generation, maintaining the temperature of the compost at its desired level. (Airone-PTT)
W87-07169

MODELING COST-EFFECTIVENESS OF AGRICULTURAL NONPOINT POLLUTION ABATEMENT PROGRAMS ON TWO FLORIDA BASINS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
C. D. Heatwole, A. B. Bottcher, and L. B. Baldwin.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 127-131, February 1987. 1 fig, 2 tab, 9 ref.

Descriptors: *Water pollution control, *Nonpoint pollution sources, *Model studies, *Economic aspects, *Agricultural management, *Basins, Florida, Water quality, Simulation, Prediction, Costs, Agriculture.

A model was developed to evaluate the cost-effectiveness of alternative 'best management practice' (BMP) implementation schemes on two agricultural basins in Florida. The model selectively applies BMPs throughout the basin on a field by field basis, estimates the associated costs, and predicts the relative water quality improvement (reductions in nitrogen and phosphorus). The water quality model links field scale simulation (for detailed BMP evaluation) with basin delivery and attenuation functions to predict the basin-wide effects of any combination of BMPs. Fifteen BMP scenarios were evaluated to aid in prioritizing BMPs for implementation in these basins. Applying the maximum level of BMPs is estimated to cost around $1.2 million (annually), while the four most cost-effective BMPs would cost only one quarter as much, yet are projected to provide approximately 90 percent of the water quality improvement. (Author's abstract)
W87-07188

IMPLEMENTATION STRATEGIES FOR AGRICULTURAL AND SILVICULTURAL NONPOINT SOURCE POLLUTION CONTROL IN CALIFORNIA AND WISCONSIN,
Wisconsin Univ.-Stevens Point. Coll. of Natural Resources.
N. E. Spangenberg.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 133-137, February 1987. 22 ref.

Descriptors: *Water pollution control, *Nonpoint pollution sources, *Agriculture, *Silviculture, California, Wisconsin, Watersheds, Policy making, Land use.

In the absence of detailed outlines such as those characteristic of the National Pollution Discharge Elimination System permit program, nonpoint source pollution control is being initiated in a variety of ways in different states. In California, Regional Water Quality Control Boards play a strong enforcement role in point source control, but agricultural nonpoint source needs are still being evaluated. Tentative approval of State Board of Forestry Forest Practice Rules by the State Water Resources Control Board has the potential of bringing nonpoint control to all State and private forestry operations in the state. Wisconsin had developed an agricultural nonpoint control program which emphasizes a state-wide policy of selecting priority watersheds under the administration of the state Department of Natural Resources, and developing implementation programs under the guidance of local county Land Conservation Committees. The Priority Watershed program institutes BMP's with cost-share funds authorized by the legislature. Wisconsin had not seen a problem in silvicultural activities, and has developed no statewide control program in that area. Common to effective land use control in both states is a state-level policy implemented by agencies within the state. This pattern may be the model for successful programs as development of areawide management strategies continue (Author's abstract)
W87-07189

GROUNDWATER CONTAMINATION CONTROL AND TREATMENT, ROCKY MOUNTAIN ARSENAL COLORADO,
Black and Veatch, Kansas City, MO.
P. MacRoberts, C. B. Hagar, and H. L. Callahan.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 65-80, 6 fig.

Descriptors: *Water quality control, *Groundwater quality, *Water pollution control, *Rocky Mountain Arsenal, *Colorado, Aquifers, Dewatering, Water pollution treatment, Activated carbon, Fluorides, Injection wells, Monitoring.

Contaminated groundwater at Rocky Mountain Arsenal, will be contained, removed from two aquifers, treated, and returned to an alluvial aquifer by this project. Major components of the system are: (1) 54 dewatering wells valved and manifolded to selectively intercept and permit separate treatment of three identified zones of contamination; (2) a 6,700-ft length of groundwater barrier keyed into bedrock; (3) granular activated carbon filters for organic contaminant removal; (4) activated alumina columns for fluoride removal; (5) 38 groundwater recharge wells downgradient of the barrier to reinject treated water into an alluvial aquifer; and (6) an arrangement of monitoring wells, located on Arsenal property, designed to provide water quality and groundwater level data to permit optimization of system effectiveness. (See also W87-07243) (Lantz-PTT)
W87-07251

3P; POLLUTION PREVENTION PAYS - A 3M SUCCESS STORY,
Minnesota Mining and Mfg. Co., St. Paul.
M. D. Koeni,gberger.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 215-221.

Descriptors: *Water pollution control, *Waste disposal, *Water quality control, *Recycling, *Economic aspects, Environmental effects, Performance evaluation, Regulations.

There are four environmental truisms: (1) Pollution is a visible sign of inefficiency in industrial operations. It is money that is going up the chimney, down the sewer, and out of a plant in waste trucks; (2) Pollution is, quite simply, the discharge of material and energy residues into the environment. Some of those residues are raw materials which are unconverted, some are products which are not fully recovered and some are by-products, but all area waste; (3) Increased corporate effort to reduce pollution can actually help to increase profits; and (4) If you make no mess, you have nothing to clean up. Pollution prevention is the environmental aspect of conservation-oriented technology, which is based on conservation in all aspects, from raw material supply and production, to consumption and disposal. The idea is to use a minimum of resources to accomplish objectives and to create a minimum of pollution. It also means learning to create resources from pollution, such as the making of nylon and other materials from the waste by-products of petroleum, as was done some years ago. The environmental benefits and economic incentives in this approach to pollution

abatement are evident. Financial and natural resources can be saved, and technology innovations can be achieved. (See also W87-07243) (Lantz-PTT)
W87-07261

WATERWAY CONTAMINATION - AN ASSESSMENT OF CLEANUP PRIORITIES,
Malcolm Pirnie, Inc.
J. C. Henningson.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 289-296, 4 tab, 11 ref.

Descriptors: *Water pollution treatment, *Sediments, *Waterways, *Path of pollutants, *Cleanup operations, Priorities, Hazardous wastes.

The contamination of sediments in the nation's waterways is a major problem. The redistribution of contamination by currents, tides and storm events often make the potential risks and impact on natural and economic resources greater than for upland sites. The potential for catastrophic releases of contaminants probably warrants that greater priority be given to waterways contamination than to many upland disposal sites. The remedial methods for contaminated sediments have been evaluated extensively and the most feasible action is usually to dredge concentrated areas before redistribution can occur and place the dredged material in secure upland disposal sites. Unfortunately, such actions are relatively costly and compound the difficulties in assessing priorities. The cleanup of an extensively contaminated waterbody such as the upper Hudson River may be several times more costly than stabilizing an upland abandoned uncontrolled waste disposal site. Several possible mechanisms are available for financing cleanups. However, the delays associated with many proposed programs have greatly increased the risk or irretrievable loss of contaminated materials due to storms or other catastrophic events less common to upland sites. It is recommended that a higher priority be considered for allocating resources to the cleanup of contaminated waterways in recognition of the special risks and potential impacts associated with such problems. (See also W87-07243) (Lantz-PTT)
W87-07267

CLEANUP OF A VINYLIDENE CHLORIDE AND PHENOL SPILL,
Williams and Works/Environmental Data Inc.
A. R. Posthuma, J. G. Kraus, and J. A. Rutherford.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 297-306, 5 fig.

Descriptors: *Cleanup operations, *Vinylidene chloride, *Phenols, *Woodland Park, *Michigan, *East Lake, Ethylene oxide, Water pollution treatment, Groundwater pollution, Wells.

In February 1978, a freight train derailed at Woodland Park, Michigan, a wooded, semi-rural resort area approximately 80 miles north of Grand Rapids. Four tank cars were damaged, and approximately 30,000 gallons (300,000 lbs) of vinylidene chloride, 40,000 gallons (330,000 lbs) of phenol, and 15,000 gallons (112,000 lbs) of ethylene oxide were lost. Because of the cold temperature at the time of the derailment, virtually all of the vinylidene remained as a liquid and percolated into the sandy soils of the site, while the phenol solidified and remained as a solid on the surface. The ethylene oxide vaporized into the air. The initial cleanup included the excavation and removal of approximately 5,000 cu yds of contaminated soil. This removed most of the phenol. By the time cleanup operations began, the vinylidene chloride had spread over 17 acres and was approaching several private wells and East Lake. Concentrations as high as 300 mg/L of vinylidene chloride were found in monitoring wells. Later investigations showed that approximately 70,000 pounds of residual phenol had been left in the soil and was flushed into the groundwater table during the cleanup programs. This also had to be removed and placed additional limitations upon the type of treatment system that could be utilized to clean up the groundwater. (See also W87-07243) (Lantz-PTT)
W87-07268

WASTE STABILIZATION BASIN DISCHARGE ELIMINATION AND REMEDIATION - A CASE STUDY,
O'Brien and Gere Engineers, Inc.
For primary bibliographic entry see Field 5E.
W87-07270

FEDERAL AND STATE ENFORCEMENT OF HAZARDOUS WASTE LAWS,
Baker, Hostetler and Patterson, Cleveland, OH.
W. W. Falsgraf.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 381-386.

Descriptors: *Law enforcement, *Legal aspects, *Hazardous wastes, *Waste disposal, *Federal jurisdiction, *State jurisdiction.

Hazardous waste disposal and the cleanup of abandoned sites and spills is a top priority item in this country. Congress has already responded to voter concerns about the handling and disposal of hazardous substances with RCRA and CERCLA and most states, including Ohio, have done likewise. However, this is not the end. The emergence of toxic tort cases such as the asbestos and black-lung claims is just beginning. Such claims, together with government enforcement actions, are certain to occupy the time of more and more industrial technicians. Those hazardous waste generators and transporters who are not so aware and persist in conducting business as usual are bound to become enmeshed in a tangled net of enforcement activity and/or private damage claims which could lead to economic losses which could well be fatal to their entire enterprise. (See also W87-07243) (Lantz-PTT)
W87-07276

GENERATOR LIABILITY UNDER SUPERFUND,
Eastman and Smith.
R. T. Sargeant.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 387-403.

Descriptors: *Legal aspects, *Liability, *Superfund, *Environmental protection, Legislation, Taxation, Leaking, Waste disposal, Environmental effects.

After a lengthy debate, the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or Superfund) was hurriedly written and passed. It was intended to provide funding and a mechanism for cleaning up leaking inactive hazardous waste sites. Despite the fact that the idea of such a fund had been debated for years, the statute that was hurriedly passed in December of 1980 was a last-minute compromise passed by a lame duck Congress just prior to the final recess in December 1980. Consequently, portions of the statute are not particularly well drafted, and the legislative history is incomplete. Indeed, there were ambiguities purposefully left in the statute by Congress because it was unable to make certain necessary policy decisions regarding liability. Issues concerning whether responsible parties under CERCLA will be subject to strict and joint and several liability are examples of these unresolved issues. While CERCLA's scope is not limited to abandoned hazardous waste sites, it was this problem that caused Congress to pass CERCLA. It was perceived that there was a large potential for harm from abandoned, but leaking facilities, and that 'something should be done'. Implicit in this position was the conclusion that the then existing environmental statutes and common law were inadequate to provide the mechanisms and resources needed to clean up those sites. Therefore CERCLA is different from most environmental statutes because its thrust is not regulation of ongoing activities (although there is some of that in the statute), but rather taxation and assignment of liability. (See also W87-07243) (Lantz-PTT)
W87-07277

ENVIRONMENTAL LAW AND CONTRACTOR LIABILITY,
Smith and Schnacke, Dayton, OH.
For primary bibliographic entry see Field 6E.
W87-07278

RESERVOIR SYSTEM ANALYSIS FOR WATER QUALITY,
For primary bibliographic entry see Field 2H.
W87-07304

MICROBIOLOGICAL DECONTAMINATION OF PENTACHLOROPHENOL-CONTAMINATED NATURAL WATERS,
Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
M. M. Martinson, J. G. Steiert, D. L. Saber, W. W. Mohn, and R. L. Crawford.
Available from the National Technical Information Service, Springfield, Virginia. 22161, as PB84-246263. Price codes: A02-PC in papercopy, A01 in microfiche. EPAReport No. EPA-600/D-84-225, September 1984. 14 p, 1 fig, 2 tab, 16 ref. EPA Grant 810016.

Descriptors: *Water pollution treatment, *Microbial degradation, *Biodegradation, *Wastewater treatment, *Decontamination, *Pentachlorophenol, *Polychlorinated biphenyls, Flavobacterium, Hydrogen ion concentration, Water temperature.

Inoculation of pentachlorophenol-contaminated natural waters with cells of a pentachlorophenol-degrading Flavobacterium was shown to be an effective method for decontamination of PCB-polluted aquatic environments. Numerous types of waters were decontaminated, including: river water, lake water, and groundwater. Decontamination was most effective between 15C and 30C, and between pH 7.5 and pH 9.0. Inoculation of waters with as few as 10,000 cells/mL resulted in effective PCP removal. PCB concentrations between 10 ppb and 100 ppm were reduced to undetectable levels, usually within 48 hours. Microbiological decontamination of PCP-polluted waters appears to be a promising waste treatment alternative when compared to traditional treatment techniques. (Author's abstract)
W87-07306

ANNUAL EFFLUENT AND ENVIRONMENTAL MONITORING REPORT FOR CALENDAR YEAR 1983.
Bettis Atomic Power Lab., West Mifflin, PA.
For primary bibliographic entry see Field 7B.
W87-07308

METHOD FOR RANKING BIOLOGICAL HABITATS IN OIL SPILL RESPONSE PLANNING AND IMPACT ASSESSMENT,
National Coastal Ecosystems Team, Slidell, LA.
J. K. Adams, K. A. Benkert, C. Keller, and R. White.
Available from the National Technical Information Service, Springfield, Virginia. 22161, as PB84-245612. Price codes: A04-PC in papercopy, A01-MF in microfiche.Report No. FWS/OBS-82/61, August 1984. 43 p, 2 fig, 9 tab, 28 ref, 3 append.

Descriptors: *Management planning, *Oil spills, *Water pollution effects, *Louisiana, Water pollution prevention, Ecological effects.

Described is a method which enables oil spill response planners to minimize the ecological impacts of oil spills by determining protection priorities for biological habitats. The objective of the method is to allow persons responding to an oil spill to quickly identify areas that should be protected first, second, and on to the extent that personnel and equipment are available. The first part of the report describes the rationale and general compo-

nents of the method. The last part presents an application of the method to the Louisiana Offshore Oil Port (LOOP) spill response planning area. (Author's abstract)
W87-07310

WATER QUALITY,
In-Situ, Inc., Lakewood, CO.
T. D. Steele.
IN: Hydrological Forecasting, John Wiley and Sons, New York, New York, 1985. p 271-309, 12 fig, 3 tab, 162 ref.

Descriptors: *Water quality, *Forecasting, *Water quality control, *Model studies, *Hydrologic models, Water resources development, Sediments.

Forecasting capabilities and needs are reviewed relative to the characterization and assessment of water quality. Present knowledge and understanding of water quality problems are considered as they affect water resources planning and management. Selected models and other predictive methods are discussed to highlight the range of techniques available for assessing the water quality characteristics of a given hydrological system. A clear definition of the study objective being addressed is a necessary prerequisite to any data collection program or modelling application from which forecasts of water quality are to be made. Without such clear specification, considerable resources might be expended without effective use of these resources or without fulfillment of the implied study objectives. For any forecasting study, once the study objective is defined and associated information needs are delineated, data requirements and model selection and application go hand-in-hand. The use of a sophisticated complex water quality model should not be chosen or attempted if insufficient data are available to operate such a model. Primary emphasis is on numerous facets of water quality. One exception involves the physical aspects of stream sediment. Sediment-modelling approaches traditionally have involved separate hydrological disciplinary expertise. Of particular concern to the discussion is the chemical interactions between dissolved constituents in the water phase and suspended sediment or underlying bottom sediments. (See also W87-07346)
W87-07356

POLLUTANT REMOVAL CAPABILITY OF URBAN BEST MANAGEMENT PRACTICES IN THE WASHINGTON METROPOLITAN AREA.
Metropolitan Washington Council of Governments, DC. Water Resources Planning Board.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-245497. Price codes: A04 in paper copy, A01 in microfiche. Final Report, October 1983. 66 p, 17 fig, 16 tab, 11 ref. EPA Grant P-003208-01.

Descriptors: *Water pollution treatment, *Water pollution prevention, *Urban runoff, *District of Columbia, *Water quality control, *Management planning, Maryland, Virginia, Monitoring, Pollution control.

A major component of the Washington area NURP project was an extensive field investigation of the comparative pollutant removal capability of seven urban best management practices (BMPs) in suburban Maryland and Virginia. This report details the major findings of this effort and is organized in the following manner. The first section provides a general description of each BMP, and also describes the individual characteristics of each monitoring site. In the second section, the various methods which were used to monitor BMPs and compute their efficiency are discussed. In the third section, each of the urban BMPs are evaluted in terms of their overall pollutant removal performance. Finally, in the last section, the major factors which appeared to influence the effectiveness of each monitored BMP are identified. Based upon this analysis, general design principles that maximize pollutant removal are proposed for each BMP type evaluated. (Lantz-PTT)
W87-07365

OIL-SPILL RISK ANALYSIS FOR THE SOUTH ATLANTIC LEASE SALE 90,
Minerals Management Service, Washington, DC.
D. E. Amstutz, W. B. Samuels, and A. D. Banks.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-241058. Price codes: A07 in paper copy, A01 in microfiche. OCS Report No. MMS 84-0037, 1984. 127 p, 6 fig, 34 tab, 16 ref, append.

Descriptors: *Oil spills, *Risk analysis, *Oil fields, *Path of pollution, Oil pollutant, Water pollution control, Gulf Stream.

This study characterizes the oil-spill risks involved in the leasing of proposed areas off the southeastern coast of the U.S. The probability of spills greater than or equal to 1,000 bbls occurring from the proposed action and contacting land within 30 days is 5%. When existing leases and existing tankering are included, this risk reaches 65%. Oil-spill risks to land from existing sources are some ten times those from the proposed action. Oil spills that might originate at the various production sites (P1-P79) and reach the U.S. shore would require considerable transit times and there would be more time to prepare for cleanup. Because of the relatively long transit times, and concomitant oil weathering, analysis of 10,000-barrel spills provides a more appropriate measure of oil-sill risks than analysis of 1,000-barrel spills. Many of the oil-spill trajectories in the study region are dominated by the Gulf Stream. Although this is not a new or unexpected finding, the present analysis contains some excellent examples. One example of the Stream's domination over oil-spill trajectories is found in the conditional probabilities to contact land from tanker route segments T59, T58, T49. Spill trajectories simulated from these tanker route segments are not related directly to the proposed action but they do contribute to the cumulative effects in the South Atlantic region. Of the three segments, trajectories from T59 pose the greatest risk to contact land and trajectories from T49 pose the least risk (94% vs 18%). The Gulf Stream turns sharply to the northeast and north upon existing the Gulf of Mexico. This intense flow exerts an influence on oil-spill trajectories from the eastern portion of T59 and the southern portion of T58 are directed nearly onshore while trajectories from T49 are directed more parallel to shore. Although winds in the area have predominant onshore components, the Stream moves the trajectories from T49 northward of latitude 27 before they can contact the coast. Spills from T59 and T58 reach shore quickly (many contact the coast within three days, and almost none require more than 10 days). Nearly all the spills from T49 that contact the shore do so within 3 days. (Lantz-PTT)
W87-07367

ECONOMIC IMPACT OF PROPOSED REGULATION R81-25: PROHIBITION OF CHLORINATED SOLVENTS IN SANITARY LANDFILLS.
Dames and Moore, Park Ridge, IL.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-243351. Price codes: A05 in paper copy, A01 in microfiche. Illinois Department of Energy and Natural Resources Report No. Doc. No. 83/08, February 1983. 70 p, 2 fig, 6 tab, 99 ref.

Descriptors: *Sanitary landfills, *Chlorinated solvents, *Regulations, *Illinois, *Waste disposal, Hazardous wastes, Environmental effects, Incineration, Cost analysis, Economic aspects.

This study presents an evaluation of the costs and benefits of proposed regulation R81-25 which would ban the landfilling of chlorinated solvents in Illinois. The disposal of chlorinated solvents is authorized (by permit) at six Illinois landfills. Alternatives to landfilling include: incineration; solvent reclamation; wet oxidation; coincineration; supercritical water reformulation; deep well injection; and solidification/encapsulation. Of those alternatives, only incineration and solvent reclamation facilities are operational in Illinois. If R81-25 is adopted, it is estimated that 80% of the solvents would be incinerated and 20% would be reclaimed. The primary cost of the regulation will be additional disposal costs: $1.21/gallon to $2.80/gallon. The primary benefits including the following: a decrease in exposure of the population around landfills; reduced potential for potable water supply contamination; an increase in the serviceable life of landfills; a decrease in liability incurred by generators and landfill operators; and an increase in revenues of firms providing disposal alternatives. (Author's abstract)
W87-07389

PREVENTION OF THE FORMATION OF ACID DRAINAGE FROM HIGH SULFUR COAL, COAL REFUSE AND COAL SPOILS BY INHIBITION OF IRON AND SULFUR OXIDIZING MICROORGANISMS,
Ohio State Univ., Columbus. Water Resources Center.
P. R. Dugan.
Availabe from National Technical Institute Service, Springfield, Virginia 22161, as PB87-190609/AS. Price codes: A0 in paper copy, A01 in microfiche. Department of the Interior, Office of Water Resources Research, Final Project Report, June 1985. 79 p, 42 fig, 2 tab, 44 ref. Project No. B-073-OHIO. DOI Grant 14-34-001-8109.

Descriptors: *Acid mine drainage, *Acid mine water, *Industrial wastewater, *Water pollution prevention, *Sulfur, *Coal mines, *Mine wastes, *Iron, *Sulfur bacteria, *Acid mine drainage, Microbial degradation, Sodium lauryl sulfate, Sodium benzoate, Biodegradation, Pyrite, Leaching, Alkyl benzene sulfonates, Detergents.

It has been estimated that 4 million tons of acidity drains into about 10,500 miles of streams in the Appalachian region each year. This pollution spans 10,000 sq mi across 11 states and also adversely affects 29,000 surface areas of reservoirs and other water impoundments. Acid drainage is a problem associated geographically and geologically with the mining industry and is due to production of sulfuric acid from sulfur containing minerals. The data presented in this report demonstrate that it is possible to inhibit pyrite oxidizing bacteria in high sulfur coal refuse with a concurrent reduction in acid drainage formed in the refuse. The most effective inhibitors studied are combinations of sodium lauryl sulfate (SLS) plus sodium benzoate (Bz), both of which are relatively nontoxic to higher organisms. Bz is approved as a human food additive and SLS is a commonly used anionic detergent that is readily biodegradable. Both are relatively inexpensive substances that are commercially available. SLS and Bz were effective alone but more effective in combination. 100 mg/L was an effective concentration in either 30% refuse slurries or in actual coal refuse. The inhibitory response of SLS and Bz was immediate but both the organisms and pyrite oxidation re-appeared within 2 to 5 weeks after treatment was terminated and the SLS leached out of the refuse. SLS and Bz were effective in the presence of lime, a chemical frequently used to naturalize acid spoils and acid drainage during reclamation. Alkyl benzene sulfonate (ABS) is also an effective inhibitor although it is required in slightly higher concentrations than SLS to achieve equal reduction of acid formation. Some organic acids are effective inhibitors (acetic, hexanoic, propionic, pyruvic) when present in considerably higher concentrations compared to SLS, ABS or Bz. The lignin sulfonate formulations examined were ineffective. Concentrations of detergent below the effective inhibitory amount actually stimulated the rate of pyrite oxidation in refuse compared to the control rate. Caution should be exercised when applying inhibitors in the field to insure that effective doses are used. (Lantz-PTT)
W87-07422

WATER QUALITY DEPENDENT WATER USES IN PUGET SOUND.
JRB Associates, Inc., Bellevue, WA.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84-242627. Price codes: A10 in paper copy, and A01 in microfiche. EPA Report No. 910/9-83-118a, March 30, 1984. 195 p, 54 fig, 13 tab, 36 ref, 6 append. EPA Contract 68-6348.

Descriptors: *Puget Sound, *Washington, *Water quality, *Water use, Water demand, Ecosystems, Water quality control, Water pollution prevention, Resources management.

The following objectives are considered in this study: (1) identify all existing and potential water quality dependent water uses within each of the subregions of Puget Sound; (2) rank the uses in terms of relative importance within each subregion in order to identify to an environmental manager those uses which should be afforded the greatest protection; and (3) whenever possible, identify the critical ecosystem elements and water quality factors which are essential to maintain these uses. A thorough treatment with respect to all of the above objectives for each of the multitude of Puget Sound water uses would require a level of effort far in excess of those contractually allocated to this task. In order to best meet the needs of the task, an attempt has been made to identify all water quality dependent water uses and address each of them to some extent. The information is formatted in such a fashion as to be amenable to expansion in the future should this effort be expanded or pursued. Section 2.0 serves to identify the water quality dependent uses and provide some background information on each use. For fisheries resources, general biological information is presented, including habitat, feeding ecology, reproductive strategy, and geographic range. Current and potential fisheries value, both commercial and recreational, is also addressed in terms of harvestable areas, catch statistics, and trends in harvesting. Recreational uses, such as swimming and diving, are considered in terms of distribution of recreational sites throughout Puget Sound. In Section 3.0, the value of these resources is examined on a regional basis, employing the subregions of Puget sound. Water quality uses that have been identified do not represent the complete array of water quality related factors that combine to make the Puget Sound area one of the most attractive and valuable within the United States. Qualities such as aesthetics and personal values are difficult or impossible to rank in terms of relative importance. Furthermore, while many species of native animals have been included, these were included primarily to document their relative importance within the Sound in terms of human exploitation. The use of Puget Sound as a habitat to a variety of non-harvested species has not been considered within the scope of this report. However, this value must ultimately be considered in any attempt to manage the complex ecosystem that exists in Puget Sound. (Lantz-PTT)
W87-07426

NATIONAL PROTOTYPE COPPER MINING WATER MANAGEMENT PLAN,
Central Arizona Association of Governments, Florence.
J. V. Rich.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84-232586. Price codes: A08 in paper copy, A01 in microfiche. Bureau of Mines Report No. OFR 145-84, August 1983. A Mining Research Contract Report. 154 p, 17 fig, 6 tab, 8 append. Bu Mines Contract J0205039.

Descriptors: *Water quality control, *Mine drainage, *Management planning, *Copper, *Water analysis, *Path of pollutants, Groundwater quality, Runoff, Geochemistry, Aquifers, Limestone.

This report describes the process, findings, conclusions and recommendations of the Globe/Miami mining and water quality project carried out by Central Arizona Association of Governments (CAAG). Included here are descriptions of the socioeconomic and physiographic characteristics of the study area, the water quality as defined in the existing literature and, through an extensive data collection effort, management practices that could be used to improve the water quality, and the unique process that was used to carry out the study. Analysis of the data came up with several conclusions, some of which are: (1) groundwater quality in the Pinal Creek Basin has been degraded over at least the past 40 years, as a result of seepage of acidic mining and milling process solutions to the groundwater resources; (2) overland runoff from old, inactive mining facilities can cause local surface waters pollution problems, but has little regional effect; (3) natural geochemical removal mechanisms of finite capacity have retarded movement of toxic groundwater pollutants; (4) the Gila Conglomerate and Paleozoic limestone aquifers within valley areas are generally protected from downward movements of contamination from the overlying alluvium by a combination of a separating residual clay barrier and upward hydraulic pressure; (5) loss of process solutions from the Rancher's Bluebird facility causes surface-water degradation in Bloody Tanks Wash and a pollution column in the alluvium along Bloody Tanks Wash. Geochemical processes are currently effective in reducing the extent of this plume; (6) additional contaminant enters the alluvium of Bloody Tanks Wash, within the Town of Miami; (7) a severe contamination plume results from subsurface flow into the alluvial system formed by the former Webster Gulch Channel. (Lantz-PTT)
W87-07429

AVOIDING FAILURE OF LEACHATE COLLECTION SYSTEMS AT HAZARDOUS WASTE LANDFILLS,
Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 5E.
W87-07430

TREATMENT REQUIREMENTS FOR ACID DRAINAGE FROM COAL STORAGE HEAPS,
SRI International, Menlo Park, CA.
D. E. Gottschlich, P. F. Greenfield, and P. R. F. Bell.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 260-277, April 1987. 7 fig, 1 tab, 41 ref, append.

Descriptors: *Model studies, *Leachates, *Water pollution treatment, *Path of pollutants, *Acid mine drainage, *Mine wastes, Prediction, Oxidation, Equations, Transport.

A model is developed and verified for predicting the generation of leachate from coal storage piles that have undergone pyrite oxidation. A number of simplifying assumptions allow an exact solution to be obtained for the equations describing the transport of the oxidation products through the heap. The oxidation products are rapidly leached from the heap, with over 90% being removed in the first three holdup volumes of liquid eluted. Combining the leachate model with a model that predicts the generation of oxidation products allows an estimate to be made of the design requirements for treating such a waste stream. (Author's abstract)
W87-07493

TREATMENT OF A LANDFILL LEACHATE IN POWDERED ACTIVATED CARBON ENHANCED SEQUENCING BATCH BIOREACTORS,
Occidental Chemical Corp., Grand Island, NY.
W.-C. Ying, R. R. Bonk, and S. A. Sojka.
Environmental Progress ENVPDI, Vol. 6, No. 1, p 1-8, February 1987. 4 fig, 8 tab, 19 ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Leachates, *Landfills, *Chemical wastes, Halogens, Organic compounds, Niagara, New York, Effluents, Detection limits, Organic loading, Waste load, Wastewater composition, Feeding rates, Biomass, Costs, Comparison studies.

The Hyde Park Landfill site, located in the Town of Niagara, New York, was used for disposal of approximately 73000 metric tons of chemical wastes, including halogenated organics, between 1953 and 1975. The leachate is collected and treated. The present wastewater treatment by the conventional adsorption technology is producing a suitable quality effluent, but is not the best long-term solution since the adsorption system would need to be expanded to accommodate the expected increase in wastewater volume. Addition of powdered activated carbon (PAC) significantly improved treatment of the chemical waste landfill leachate in sequencing batch reactors (SBRs). Concentrations for many of the monitored halogenated organic compounds in the effluent were below their respective detection limits. Excellent treatment efficiency was achieved under a variety of operating conditions: wastewater composition, feed rate, hydraulic retention time, organic loading, PAC dosages, biomass, and PAC concentrations in the bioreactors. The PAC-SBR performance was unaffected when wastewater feeding was suspended during weekends and holidays. The PAC-SBR treatment cost is much lower than either that of the conventional granular activated carbon adsorption technology or the two-stage process of biodegradation and carbon treatment. (Wood-PTT)
W87-07530

RHINE SPILLS FORCE RETHINKING OF POTENTIAL FOR CHEMICAL POLLUTION,
P. L. Layman.
Chemical and Engineering News CENEAR, Vol. 65, No. 8, p 7-11, February 1987.

Descriptors: *Water pollution sources, *Path of pollutants, *Water pollution control, *Rhine River, *Rivers, Pollutants, Chemical industry, Switzerland, Environmental protection, Environmental policy, Water pollution.

A fire-related spill of toxic chemical at the Sandoz facility in Switzerland in 1986 followed by other releases from chemical firms along the Rhine caused damage to the ecosystem and affected water quality in the river. Municipal waterworks and breweries drawing water from the Rhine were advised to use other sources. As the chemical slicks progressed downstream toward the Netherlands, the Dutch were forced to manipulate their system of sluices to prevent contamination of canal water. As a result of the disaster, Swiss environmental protection laws were reviewed and new ordinances are being prepared. Chemical storage and shipping practices are expected to change as governments tighten environmental regulations. (Wood-PTT)
W87-07539

MASSIVE GROUNDWATER FIX STUDIED,
J. J. Kosowatz, and M. J. Sponseller.
Engineering News - Record ENREAU, Vol. 217, No. 21, p 28-29, November 1986.

Descriptors: *Cleanup, *Groundwater management, *Public policy, *Contamination, *California, *Water treatment, *Water pollution, *Aquifers, Groundwater, Decontamination, Chlorinated hydrocarbons, Water supply, Water rights, Legal aspects, State jurisdiction, Water quality management, Water policy.

Southern California faces a serious threat to scarce groundwater supplies due to high concentrations of volatile organic chemicals found within the San Gabriel Basin. Four large contaminant plumes have been found; about 65,510 acre-ft of water are potentially involved, affecting more than one million persons living southeast of Los Angeles. Although specific remedial measures have not yet been proposed, adjudicated water rights, strict pollution control laws, high costs, and the large number of municipal and private water systems involved promise to make cleanup a costly and complex issue in the San Gabriel Valley. Officials are searching for responsible parties while attempting to determine how to cleanse the aquifer. Replacement of contaminated groundwater by imported surface water is likely to be ruled out because of high costs and dwindling surface supplies. Air stripping is considered undesirable because it would require expensive air pollution controls. Whatever the eventual remedy, it is expected to involve limitations on the quantity and location of pumping, thereby disrupting the water rights of many users. (Doria-PTT)
W87-07541

GROWING CLEAN WATER NEEDS CONFRONT A CAPITAL CRUNCH,
R. Isaac.
Engineering News - Record ENREAU, Vol. 217,

No. 24, p 20, December 1986. 2 tab.

Descriptors: *Economic aspects, *Capital, *Water demand, *Financing, *Water quality management, *Legislation, *Legal aspects, Water supply, Grants, Taxes, Wastewater management, Administrative agencies, Contracts, Federal jurisdiction.

The United States water construction market is reviewed. Wastewater treatment projects are expected to become more dependent on credit markets as a result of federal cutbacks and tax revision. Municipal water treatment agencies will face a financial crunch as a result of new restrictions on municipal bonds, a phaseout of direct federal grants in the new Clean Water Act, and the loss of federal and state revenue-sharing in 1989. Sewage treatment awards for 1986 have already declined; cumulative October 1986 awards showed a 4% decline over the same 10-month period last year. It is predicted that clean water enforcement may encourage growth in public and private partnerships, with municipal sewer authorities owning the treatment plant and public distribution lines, while private partners could control the more risky sludge management activities. (Doria-PTT)
W87-07544

POLLUTION WATCH ON THE RHINE,
P. M. Block, L. Pilarski, M. Hibbs, A. Hope, and D. Hunter.
Chemical Week CHWKA9, Vol. 139, No. 21, p 20, 22, November 1986.

Descriptors: *Rhine River, *Contamination, *Disasters, *Water pollution, *Water pollution effects, *Cleanup, Decontamination, Costs, Herbicides, Insecticides, Pesticides, Heavy metals, Mercury, Aquatic life, Bioaccumulation, Path of pollutants.

Switzerland and Sandoz will bear the costs of cleanup and compensatory damages related to the pollution of the Rhine River that followed efforts to extinguish a fire at a Sandoz chemical warehouse near Basel, Switzerland on November 1, 1986. The Swiss government has also conceded the country's need to meet European Community (EC) standards for safety in chemical facilities and in toxic substance handling. Damage to the Rhine has been severe, with hundreds of thousands of fish and eels killed by an estimated 10-30 tons of pesticides and mercury compounds. Other types of aquatic life, such as water fleas, have also been affected. The contamination has caused an environmental emergency in the four countries bordering the Rhine (Switzerland, Germany, France, and the Netherlands), and may pose a particular problem for the Netherlands, where river water is used for irrigation and drinking. The Commission has announced that it may press for the adoption of an international convention between the EC riparian states and Switzerland to upgrade its antipollution measures and industrial accident reporting systems. (Doria-PTT)
W87-07584

CONTROL STRATEGIES FOR THE PROTECTION OF THE MARINE ENVIRONMENT,
Department of the Environment, Halifax (Nova Scotia). Office of the Regional Director General.
H. Hirvonen, and R. P. Cote.
Marine Policy, Vol. 10, No. 1, p 19-28, January 1986. 1 fig, 4 tab, 22 ref.

Descriptors: *Marine environment, *Water quality management, *Water pollution control, *Environmental protection, *Management planning, *Water policy, *International agreements, Environment, Planning, Water pollution sources, Priorities, Legislation, Public policy, Legal aspects, Standards, Water quality standards, Technology, Coastal zone management.

The recognition of the need for a comprehensive approach to marine environmental protection has led to the efforts by 164 nations to formulate the Law of the Sea and to the Regional Seas Action Plans of the United Nations Environmental Program. However, while most of the action plans have noted land-based sources as significant contributors of pollutants, very little attention has been paid to an analysis of strategies available to countries wishing to tackle these sources. A major initiative in this area was the development of the Montreal Guidelines for the Protection of the Marine Environment Against Pollution from Land-based Sources. The background for Annex I of these guidelines is discussed, including the range of strategies available as well as the factors associated with their implementation. These strategies are couched in a broader ecological perspective, termed 'environmental capacity', which provides the objective. Three basic groups of strategies are discussed: (1) marine environmental quality controls; (2) emission or source controls; and (3) environmental planning controls. (Doria-PTT)
W87-07589

CONTROL OF MARINE POLLUTION GENERATED BY OFFSHORE OIL AND GAS EXPLORATION AND EXPLOITATION: THE SCOTIAN SHELF,
Braidwood, MacKenzie, Brewer and Greyell, Vancouver (British Columbia).
S. M. Evans.
Marine Policy, Vol. 10, No. 4, p 258-270, October 1986. 1 fig, 151 ref.

Descriptors: *Marine environment, *Water pollution control, *Water quality management, *Oil industry, *Industrial wastes, *Legal aspects, *Nova Scotia, Wastes, Environment, Hydrocarbons, Waste disposal, Toxicity, Ecosystems, Environmental effects, Ecological effects, Monitoring, Fate of pollutants, Organic compounds, Heavy metals, Regulations, Water pollution effect.

Discharged effluents generated by daily drilling operations during offshore oil exploration and exploitation are an insidious source of marine pollution. The impact of operational discharges on the marine environment is discussed, along with methods of physical and legislative control, with special reference to the continental shelf adjacent to Nova Scotia. Major sources of such pollution include drilling mud, drill cuttings, and produced water. Effects range from total disruption of marine ecosystems to sublethal effects and bioaccumulation. Regulations for the control of marine pollution are discussed and evaluated. Recommendations for legislative improvement fall into the categories of prevention, containment, and monitoring. Prevention measures include banning diesel oil for certain uses, adopting toxicity standards for oil-based mud, prioritizing chemical regulation based on toxicity, and stationing an enforcement agent on each rig. Containment may be increased by using best practicable treatment technologies for waste treatment and installing safety side panels adjoining the drill deck. Monitoring may be improved by upgrading laboratory methods and continually monitoring biota, water, and sediment. It is concluded that, although the expense of such measures may be considerable, it is balanced by the interests of the fishing industry and other users of the offshore. (Doria-PTT)
W87-07590

NEUTRALIZATION OF ACIDIC BROOK-WATER USING A SHELL-SAND FILTER OR SEA-WATER: EFFECTS ON EGGS, ALEVINS AND SMOLTS OF SALMONIDS,
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
B. O. Rosseland, and O. K. Skogheim.
Aquaculture AQCLAL, Vol. 58, No. 1/2, p 99-110, November 1986. 4 fig, 1 tab, 22 ref.

Descriptors: *Limnology, *Acid rain, *Neutralization, *Acidic water, *Seawater, *Fish eggs, *Smolt, *Salmon, *Sand filters, *Trout, *Fish farming, Water pollution effects, Eggs, Fish, Filters, Hydrogen ion concentration, Acidity, Aquaculture, Aluminum, Fish hatcheries, Mortality, Toxicity, Water treatment.

A shell-sand filter and additions of sea water were used to neutralize acidic brook water used for culturing Atlantic salmon, Arctic char, and brook trout. Passage of the acidic water through the filter increased the pH from 4.8-5.3 to 6.4-7.4; addition of 3% (v/v) sea water increased the pH to 5.6-6.4. The pH levels resulting from the sea water additions were less stable than those obtained with the filter. The sea water additions reduced the concentrations of labile aluminum in the hatchery channels by 0-50%. Passage through the filter generally resulted in even greater reductions in labile aluminum, as expected from the higher pH. Cumulative mortalities in untreated brook water were 23, 40, and 25% for salmon, char, and brook trout, respectively. Sea water additions reduced the mortality rate to 1, 15, and 10%, whereas passage through the filter reduced it to 1, 6, and 9%, for salmon, char, and brook trout, respectively. Treated water from the channel outlets was led into small fish tanks containing Atlantic salmon smolts. The mortality rate was 100% after six days in the acidic brook water, whereas no smolts died in the shell-sand filter and sea water-treated water. (Author's abstract)
W87-07593

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

NETWORK MODEL FOR DECISION-SUPPORT IN MUNICIPAL RAW WATER SUPPLY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Labadie, D. A. Bode, and A. M. Pineda.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 927-940, December 1986. 9 fig, 3 tab, 16 ref.

Descriptors: *Model studies, *MODSIM3, *Decision making, *Water supply, *River basins, *Fort Collins, *Optimization, *Water resources development, Planning, Management, Raw water, Networks, Municipal water.

A water supply network optimization model called MODSIM3 was developed as a decision-support tool for aiding city staff in determining how best to utilize and exchange existing and potential water supplies with other users in a river basin. The model was applied to the City of Fort Collins, Colorado, water supply system as a means of determining optimum ways the City can utilize direct flow rights, storage rights, and exchangeable waters from various sources. Results clearly confirm both the benefits of the use of exchanges and the value of MODSIM3 as a water supply planning and management tool. (Authors' abstract)
W87-06686

SOCIAL FEASIBILITY AS AN ALTERNATIVE APPROACH TO WATER RESOURCE PLANNING,
Virginia Water Resources Research Center, Blacksburg.
M. S. Hrezo.
Water Resources Bulletin WARBAQ, Vol. 22, No. 6, p 1001-1009, December 1986. 2 tab, 58 ref.

Descriptors: *Water resources development, *Public participation, *Model studies, *Social feasibility, *Policy making.

Research suggests that conflict over public participation in water resource planning is due, in part, to confusion over the nature of the policies involved. The roadblocks to citizen involvement in water resource planning was examined in terms of two policy models: (1) the Social Feasibility Model and (2) the Political Feasibility Model. Each model posits a different role for public participation. Although the Political Feasibility Model has been widely accepted in water resource planning, changes in the nature of the policies involved in water resource management have weakened its appropriateness. Currently, social and redistributive policies involving value conflicts often dominate water planning and these policies are best chosen through the Social Feasibility Model. The nature of the social feasibility model, new types of policy decisions facing water resource managers, and how the social feasibility model can help overcome the roadblocks to increased public participa-

tion in water resource policy making are discussed. (Author's abstract)
W87-06692

QUALITY AND UNCERTAINTY ASSESSMENT OF WILDLIFE HABITAT WITH FUZZY SETS,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W87-06713

STATISTICAL IDENTIFICATION OF HYDROLOGICAL DISTRIBUTED-PARAMETER SYSTEMS: THEORY AND APPLICATIONS,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
For primary bibliographic entry see Field 4B.
W87-06813

HYDROLOGIC INFLUENCES ON THE POTENTIAL BENEFITS OF BASINWIDE GROUNDWATER MANAGEMENT,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W87-06819

APPROPRIATE TECHNOLOGY FOR PLANNING HYDROELECTRIC POWER PROJECTS IN NEPAL: THE NEED FOR ASSUMPTION ANALYSIS,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W87-07030

EVALUATION OF A 'RELIABILITY PROGRAMMING' RESERVOIR MODEL,
Institute of Atomic Energy, Otwock-Swierk (Poland).
For primary bibliographic entry see Field 2H.
W87-07103

ESTIMATING FRESHWATER INFLOW NEEDS FOR TEXAS ESTUARIES BY MATHEMATICAL PROGRAMMING,
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2L.
W87-07104

COMPARISON OF STOCHASTIC AND DETERMINISTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPERATING RULE GENERATION,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
M. Karamouz, and M. H. Houck.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 1-9, February 1987. 1 fig, 12 tab, 19 ref. NSF Grant CME 7916819.

Descriptors: *Dynamic programming models, *Model studies, *Reservoir operation, *Algorithms, Regression analysis, Simulation, Streamflow, Stochastic process, Performance evaluation, Reservoirs.

Two dynamic programming models, one deterministic and one stochastic, that may be used to generate reservoir operating rules are compared. The deterministic model (DPR) consists of an algorithm that cycles through three components: a dynamic program, a regression analysis, and a simulation. In this model, the correlation between the general operating rules, defined by the regression analysis and evaluated in the simulation, and the optimal deterministic operation defined by the dynamic program is increased through an iterative process. The stochastic dynamic program (SDP) describes streamflows with a discrete lag-one Markov process. To test the usefulness of both models in generating reservoir operating rules, real-time reservoir operation simulation models are constructed for three hydrologically different sites. The rules generated by DPR and SDP are then applied in the operation simulation model and their performance is evaluated. For the test cases, the DPR generated rules are more effective in the operation of medium to very large reservoirs and the SDP generated rules are more effective for the operation of small reservoirs. (Author's abstract)
W87-07175

PRIORITIZING FLOOD CONTROL PLANNING NEEDS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07201

PUBLIC PARTICIPATION IN OHIO EPA'S SOLID AND HAZARDOUS WASTE PROGRAM,
For primary bibliographic entry see Field 5E.
W87-07246

SITE SELECTION AND DESIGN CONSIDERATIONS FOR HAZARDOUS WASTE LAND DISPOSAL FACILITIES,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 5E.
W87-07265

FORECASTING WATER USE ON FIXED ARMY INSTALLATIONS WITHIN THE CONTIGUOUS UNITED STATES,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W87-07302

6B. Evaluation Process

SOCIAL FEASIBILITY AS AN ALTERNATIVE APPROACH TO WATER RESOURCE PLANNING,
Virginia Water Resources Research Center, Blacksburg.
For primary bibliographic entry see Field 6A.
W87-06692

STRATEGIC USE OF TECHNICAL INFORMATION IN URBAN INSTREAM FLOW PLANS,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
B. L. Lamb, and N. P. Lovrich.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 42-52, January 1987. 1 tab, 20 ref.

Descriptors: *Urban planning, *Multiobjective planning, *Urban areas, *Public policy, Governmental interrelations, Political aspects, Public participation, San Antonio.

A number of cities hope to follow the example of San Antonio, Texas, in developing a viable tourist/retail park near an urban river. While this is an appealing idea, problems are associated with such a task, including the problem of ensuring that water flows through the park. Success in such an important undertaking depends on a three-part strategy: (1) understanding laws; (2) projecting agency concerns; and (3) using technical information. The authorities vary according to state water law. Understanding the concerns of agencies involves understanding data needs, anticipating resistance to plans, and assessing the roles of supporters and opponents. Four roles which water resources management agencies commonly assume, addresses issues pertaining to urban instream flow programs, and discusses the agency concerns associated with each role are described. Because effective use of technical information is required to both address these agency concerns and to explain urban instream flow programs to the general public, recent research on water resource 'knowledge holding' is also described. Research suggests that public acceptance of programs intended to preserve water resources is enhanced by the possession of knowledge concerning local water resources, even among those ideologically opposed to such programs. (Authors' abstract)
W87-06709

RESERVOIR MANAGEMENT IN TEXAS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W87-06715

METHOD FOR EVALUATING REGIONAL WATER SUPPLY AND CONSERVATION ALTERNATIVES FOR POWER GENERATION,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 6D.
W87-07016

WASTEWATER TREATMENT ACQUISITION STRATEGY FOR TEXAS COMMUNITIES,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 5D.
W87-07020

COST EFFICIENCY OF TIME-VARYING DISCHARGE PERMIT PROGRAMS FOR WATER QUALITY MANAGEMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-07106

GROUNDWATER CONTAMINATION FROM WASTE MANAGEMENT SITES: THE INTERACTION BETWEEN RISK-BASED ENGINEERING DESIGN AND REGULATORY POLICY: 1. METHODOLOGY,
Hart, Crowser and Associates, Inc., Seattle, WA.
For primary bibliographic entry see Field 5E.
W87-07115

GROUNDWATER CONTAMINATION FROM WASTE MANAGEMENT SITES: THE INTERACTION BETWEEN RISK-BASED ENGINEERING DESIGN AND REGULATORY POLICY: 2. RESULTS,
Hart, Crowser and Associates, Inc., Seattle, WA.
For primary bibliographic entry see Field 5E.
W87-07116

SMALL COMMUNITIES HELP THEMSELVES,
N. Goldstein.
Biocycle BCYCDK, Vol. 28, No. 2, p 36-40, February 1987.

Descriptors: *Wastewater treatment, *Local governments, *Organizations, *Financing, *Project planning, Decision making, Financial feasability, New York State, Septic tanks, Costs, Sand filters.

The Self-Help Support System is a concept (developed by The Rensselaerville Institute in New York) which has been applied in New York State to programs designed to assist small communities (less than 500 connections) with their water and wastewater problems. Administered through New York's Departments of State, Environmental Conservation, and Health, the Self-Help Support System helps small communities plan needed water development projects in a way that minimizes otherwise prohibitive costs by maximizing use of local labor and talent (including voluntary labor), and by choosing technologies that are simpler and less expensive to install and maintain, e.g., sand filters where possible instead of an activated sludge process. Examples of three communities (Seward, Willsboro and DePauville) are described, as are sources of further information about the Self-Help System. (Airone-PTT)
W87-07168

VALIDATION OF SWRRB-SIMULATOR FOR WATER RESOURCES IN RURAL BASINS,
Agricultural Research Service, Temple, TX.
J. G. Arnold, and J. R. Williams.
Journal of Water Resources Planning and Manage-

ment (ASCE) JWRMD5, Vol. 113, No. 2, p 243-256, March 1987. 4 fig, 10 tab, 10 ref, append.

Descriptors: *Model testing, *SWRRB model, *Model studies, *Rural basins, *Streamflow forecasting, *Path of pollutants, *Sediment yield, *Soil erosion, *Water resources, *Simulation, Weather, Hydrology, Sedimentation, Watersheds, Planning, Calibrations.

A model called SWRRB (simulator for water resources in rural basins) was developed for simulating hydrologic and related processes in rural basins. The SWRRB model was developed by modifying the CREAMS (chemicals, runoff, and erosion from agricultural management systems) daily rainfall hydrology model for application to large, complex, rural basins. The three major components of SWRRB are weather, hydrology, and sedimentation. Processes considered include surface runoff, return flow, percolation, evapotranspiration, transmission losses, pond and reservoir storage, sedimentation, and crop growth. SWRRB has been tested on 11 large watersheds from eight Agricultural Research Service (ARS) locations throughout the United States. The results show SWRRB can realistically simulate water and sediment yields under a wide range of soils, climate, land-use, topography, and management conditions. SWRRB should provide a versatile and convenient tool for use in planning and designing water resources projects. (Author's abstract)
W87-07198

GREAT LAKES POLICIES AND HYDROSPHERIC AND ATMOSPHERIC RESEARCH NEEDS,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
S. A. Changnon.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 274-282, March 1987. 1 tab, 15 ref. NSF Grant ATM85-A00846.

Descriptors: *Great lakes, *Public policy, *Hydrospheric research, *Atmospheric research, *Research priorities, Acid rain, Water quality, Lakes, Policies.

Public policies in the Great Lakes have traditionally developed in an ad hoc manner as specific issues occurred. Recently, the transboundary pollution problems have caused this historical approach to become inadequate. Key policy issues now are acid rain, water quality, and lake levels and quantity. These policy issues were examined to help define research needs in the atmospheric and hydrospheric sciences so as to help resolve future policy issues. However, policy development and in-depth documentation of policies are needed for the Great Lakes to enable development of sound research agenda. (Author's abstract)
W87-07200

ACHIEVING SUCCESS IN COMMUNITY WATER SUPPLY AND SANITATION PROJECTS.
World Health Organization, New Delhi (India). Regional Office for South-East Asia.
World Health Organization Regional Office for South-East Asia, New Delhi. SEARO Regional Health Papers No. 9, 1985. 67 p.

Descriptors: *Water supply, *Public participation, *Sanitation, *Water supply development, *Management planning, Water supply development, Community development, Management planning.

There are three major problems that often cause community water supply and sanitation projects (and programs) to fail to achieve their objectives: (1) the conceptual gap between local people and planners; (2) over emphasis on population coverage, rather than on the continued functioning and utilization of the facilities; and (3) lack of effective backup support to communities, particularly after the completion of the project. In order to achieve success in their projects, planners must follow a well-designed procedures, which involves people and planners in a joint search for the proper mix of hardware and software to meet community needs. The six-step procedure presented in this publication has been designed to accomplish this end. The procedure uses community education and participation as a vehicle in the search, and makes use of the assistance of local project facilitators to mobilize the effort. The establishment of a local institution for the future management, operation and maintenance of facilities is viewed as a pre-requisite to ensure their optimal functioning and utilization in most situations. Planners are asked to change their style, and go out of their way to identify and listen to disadvantaged groups, including women and children. 'Software', such as institutional development and investments in human resources development are seen as important components of the proper mix. Planners are cautioned not to promote a specific technology, but to find an appropriate technology through the use of appropriate procedures for community involvement. The demonstration of community consensus and commitment are viewed as indicators of success, as flexible planners can win people's hearts and help the community feel satisfied. Following construction and implementation, a link is forged between the local institution and available program support networks for backup as required. An appropriate procedure for involving communities can serve to overcome the conceptual gap between people and planners. The six-step procedure outlined, can be incorporated into existing programs to improve the success of projects in the field. In this way, planners work closely with the people to determine community needs and to develop popular support for actions to meet the needs identified. (Lantz-PTT)
W87-07363

INVESTMENTS IN LARGE SCALE INFRASTRUCTURE IRRIGATION AND RIVER MANAGEMENT IN THE SAHEL,
Fletcher School of Law and Diplomacy, Medford, MA.
J. D. Stryker, C. H. Gotsch, J. McIntire, and F. C. Roche.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-245455. Price codes: A07 in paper copy, and A01 in microfiche. January 1981. 117 p, 5 tab, 106 ref, 2 append. Agency for International Development Contract AID/afr-C-1130.

Descriptors: *Sahel, *Management planning, *Irrigation, *River regulations, *Economic aspects, *Sudan, *Mali, *Chad, *Upper Volta, *Mauritania, *Niger, *Gambia, *Senegal, Water resources development, Semiarid lands, Cost analysis, Irrigation practices.

To determine whether large-scale irrigation infrastructure projects (IIP) in the Sahel are consistent with the Congressional mandate that A.I.D. projects benefit the poor majority, this report reviews existing IIP's and the Sahel's current irrigation needs in light of the mandate's legislative history. The U.S. Congress, it is argued, is willing in principle to finance large-scale IIP's in the Sahel if it can be shown that no better alternatives exist, and that the majority of benefits would accrue to small producers with secure land tenure. IIP's in the Sahel and worldwide, as well as the two largest IIP's in sub-Saharan Africa, in Sudan and Mali, are reviewed to develop a typology of IIP's aiding the poor. Results show that large-scale IIP's are likely to be costly and of scant benefit to the poor if carried out using capital-intensive construction and cultivation techniques (CCT), but that technically and economically viable alternatives exist which would substantially benefit the poor without being socially disruptive. The system envisioned would involve total water control and at least two crops per year, both labor-intensive and mechanized CCT's, traditionally based farmer organizations, and both commercial and food crop production. A review of current irrigation systems and needs for river flow regulation in each Sahelian country and major river basin indicates that the potential for expanding rainfed agriculture and small-scale irrigation - development of which must begin now - is best in Chad, Mali, and Upper Volta and poorest in Mauritania and Niger, with the Gambia and Senegal holding intermediate positions. (Lantz-PTT)
W87-07388

TEST OF PROTOTYPE REVERSE OSMOSIS ENERGY RECOVERY DEVICE AND CORRECTION OF ITS DEFICIENCIES,
Polymetrics, Inc., Santa Clara, CA.
For primary bibliographic entry see Field 3A.
W87-07424

ONTARIO'S WETLAND EVALUATION SYSTEM WITH REFERENCE TO SOME GREAT LAKES COASTAL WETLANDS,
Canadian Wildlife Service, Ottawa (Ontario).
For primary bibliographic entry see Field 2H.
W87-07442

WETLAND THREATS AND LOSSES IN LAKE ST. CLAIR,
Canadian Wildlife Service, London (Ontario).
For primary bibliographic entry see Field 2H.
W87-07444

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DESIGNING A COST-EFFICIENT AIR-STRIPPING PROCESS,
For primary bibliographic entry see Field 5F.
W87-06770

AUTOMATION OF THE WATER AND SEWER BILLING PROCESS,
Genesee County Water and Waste Services, FLint, MI.
R. McVay, and C. Secrest.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 67-79, 4 fig, 6 tab.

Descriptors: *Water rates, *Billing systems, *Automation, *Sewage rate, *Computers, *Flint, *Michigan, Computer programs, Data processing, Process control.

Medium sized utility offices have generally required the speed and memory capacity of a mainframe computer for processing data, printing of bills and report generation. These machines are highly complex, large and expensive to operate, and require significant space and climate control for proper operation. Operation of these machines is limited to those with extensive training in computer science. Mainframe computers must be supported with software which is usually leased at significant cost. Little flexibility is provided by these machines for producing custom reports. Recent advances in computer technology have resulted in the production of minicomputers with capabilities and computing power now approaching that of larger machines. Minicomputers offer substantial savings in maintenance and support costs. When these machines are used in combination with microcomputers, considerable flexibility for custom report generation is provided and improved access to the minicomputer is retained. Technological advances have additionally resulted in the production of solid state interrogators for meter reading purposes. These 'smart guns' are actually microcomputers which store data in a format accessible to larger machines. Demonstrated are the cost savings and efficiencies that may be realized by choosing an automated billing system, maximizing the benefits obtainable from a combination system of mini- and microcomputers and solid state meter reading devices. The application of this equipment to the billing process and working examples of the varied uses of the computer combination will be presented. The equipment is utilized at the Genesee County Drain Commissioner's Division of Water and Waste Services, a medium sized water and waste utility in Flint, Michigan. (See also W87-06965) (Lantz-PTT)
W87-06972

UTILITY RATE STUDIES - DEVELOPMENT OF USER CHARGE SYSTEMS,
Camp, Dresser and McKee, Inc., Detroit, MI.
D. J. Vaclavik.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 81-92, 7 tab.

Descriptors: *Utilities, *Rate schedules, *Computers, Computer programs, Mathematical studies, Databases, Taxes, Costs.

The development of utility rates has been greatly aided by the progress that has been made in the computer industry. Calculations formerly made by hand with the use of a calculator or adding machine are now more effectively made by powerful computers capable of performing multiple operations. Anyone familiar with rate studies is aware of the large number of calculations that are performed in achieving the final rates. Most of these calculations involve tabular data for which spreadsheet programs were specifically developed. Although more expensive, spreadsheets also have been developed for larger computers. Many of the office automation systems being established include a spreadsheet program that is fully adequate for rate development. These systems also provide the added advantage of being able to integrate with text generated on the word processing system and to access information stored in database files. These systems are becoming more available as the price of minicomputers continues to decline. Included is a discussion of the use of computer systems to design and analyze potential utility rate methodologies. The primary focus is on the use of microcomputers and spreadsheet applications to develop rates. Some attention is also given to larger systems using either other spreadsheets or specific programs written with a programming language such as Fortran or Pascal. Primary advantages of a microcomputer-based spreadsheet model are low cost, availability, ease of development, the ability to change variables and assumptions easily, and the comfort and familiarity that many users have developed with these systems. The interactive style provided by a spreadsheet makes it convenient to quickly put together alternative solutions and test ranges of variables. Rate analysis includes a number of distinct tasks: determination of revenue requirements, analysis of usage/discharge characteristics, development of user classes, assignment of costs to classes, and calculation of rates. (See also W87-06965) (Lantz-PTT)
W87-06973

INPUT SUBSTITUTION AND DEMAND IN THE WATER SUPPLY PRODUCTION PROCESS,
Western Kentucky Univ., Bowling Green. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W87-07105

COST EFFICIENCY OF TIME-VARYING DISCHARGE PERMIT PROGRAMS FOR WATER QUALITY MANAGEMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-07106

ECONOMIC FEASABILITY OF ANAEROBIC DIGESTERS,
For primary bibliographic entry see Field 5D.
W87-07171

MODELING COST-EFFECTIVENESS OF AGRICULTURAL NONPOINT POLLUTION ABATEMENT PROGRAMS ON TWO FLORIDA BASINS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W87-07188

URBAN WATER PRICING AND DROUGHT MANAGEMENT,
Hawaii Univ. at Manoa, Honolulu. Dept. of Economics.
J. E. T. Moncur.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 393-398, March 1987. 2 fig, 4 tab, 19 ref.

Descriptors: *Water pricing, *Urban water, *Drought management, *Residential water, *Water demand, Honolulu, Estimating, Water conservation.

In periods of drought, urban water systems commonly rely on nonmarket programs to induce temporary conservation, leaving the marginal price of water unchanged; an alternative is to raise the price. Using pooled cross-sectional and time series observations on single-family residential customers of the Honolulu Board of Water Supply (1982), demand for water is estimated as a function of price, income, household size, rainfall, and a dummy variable denoting a water restrictions program. Short-run elasticities suggest that an increase in marginal price of less than 40% would achieve a 10% reduction in water use, even during a drought episode. An accompanying conservation program would mitigate the necessary price increase, but only slightly. (Author's abstract)
W87-07470

BUREC COST ESCALATION CONTINUES,
R. Isaac.
Engineering News - Record ENREAU, Vol. 217, No. 25, p 57, December 1986 1 tab.

Descriptors: *Economic aspects, *Construction costs, *Bureau of Reclamation, *Construction, *Financing, *Costs, Earthworks, Diversion, Administrative agencies, Prices, Dams, Concretes, Hydraulic structures, Canals, Powerplants, Pipelines.

Water and power construction costs are reviewed for the fourth quarter of 1986. Cost hikes on Bureau of Reclamation (BuRec) projects continued a slow, steady climb; average prices for BuRec work rose 0.6% from April to July and again from July through October. BuRec cost escalation is below the national economy's 3.3% third quarter annual inflation rate. However, a noticeable difference from last quarter is the apparent entrenchment of rising prices; low bids on 10 new contracts overtopped BuRec's total estimated cost of $61.3 million by 3.5%. Competition for BuRec projects has dropped substantially, which is expected to lead to higher costs. Costs were up in 28 construction categories as the final quarter began, but only 15 categories posted increases at the advent of the third quarter. It is predicted that, unless the economy turns down abruptly, 1987 costs will settle into a pattern of steady escalation. (Doria-PTT)
W87-07546

6D. Water Demand

WATER DUTIES: ARIZONA'S GROUNDWATER MANAGEMENT APPROACH,
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 4B.
W87-06712

TO QUENCH OUR THIRST: THE PRESENT AND FUTURE STATUS OF FRESHWATER RESOURCES OF THE UNITED STATES,
Oklahoma State Univ., Stillwater. Dept. of Botany and Microbiology.
D. A. Francko., and R. G. Wetzel.
The University of Michigan Press, Ann Arbor, Michigan. 1986. 148 p.

Descriptors: *Water demand, *Water supply, *Water quality control, Water pollution control, Water pollution effects, Aquatic environment, Silt, Nutrients, Soil contamination, Erosion.

For simplicity, current water problems can be divided into two functional groups: (1) problems in water supply and demand, and (2) problems in the degradation of water supplies and of the terrestrial environment necessary for effecting water supply recharge. Supply and demand problems occur when, for a number of reasons, human use of water exceeds the supply of readily extractable water in a given area. To understand supply and demand problems, the dynamics of liquid water in the environment and how man influences the movement of water in the hydrological cycle must be understood. The degradation of water supplies occurs in two ways. First, man adds solid, liquid, or gaseous pollutants to the air, water, or land and these contaminants eventually find their way to stored water supplies. Second, man can alter the terrestrial landscape, so that erosion and other processes overload aquatic systems with silt, nutrients, and soil-borne contaminants. The rate of movement of water from sources to eventual flow to the oceans is also accelerated, reducing the recharge of groundwater supplies. This book discusses both of these broad classes of water-related problems. Examined are the specific aspects of the present acute crises in America, and the ramifications for the future. (Lantz-PTT)
W87-06849

WATER NETWORK ANALYSES,
Wade, Trim and Associates, Inc., Taylor, MI.
For primary bibliographic entry see Field 7A.
W87-06974

FORECASTING MUNICIPAL WATER USE DURING A DROUGHT: A CASE STUDY OF DEERFIELD BEACH, FLORIDA,
Texas Univ. at Austin. Dept. of Civil Engineering.
S. L. Franklin, and D. R. Maidment.
Technical Report No. CRWR 188, March 1983. 103 p, 33 fig, 16 tab, 43 ref. 2 append.

Descriptors: *Water use, *Municipal water, *Drought, *Case studies, *Tiem series analysis, *Deerfield Beach, *Florida, Forecasting, Rainfall, Water management, Mathematical studies, Forecasting, Prediction.

As an aid in municipal water management, a methodology of producing one-step-ahead forecasts based on a time series analysis is presented. This method separates water use into four components; long term growth, seasonal cycle, autocorrelation and correlation with rainfall. Deerfield Beach, Florida, is used as a test case. Forecasts of water use were made for 1981, a drought year, using the parameters estimated from analysis of water use in 1976-80, a period of more normal weather. Forecasts of water use one month ahead have an average absolute relative error of 8.0%, while forecasts for one week ahead have an average absolute relative error of 8.4% (7.7% if the forecast of the first week of 1981 is ignored). (Author's abstract)
W87-07001

EFFECTS OF FLOW ALTERATIONS ON TROUT, ANGLING, AND RECREATION IN THE CHATTAHOOCHEE RIVER BETWEEN BUFORD DAM AND PEACHTREE CREEK,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W87-07006

METHOD FOR EVALUATING REGIONAL WATER SUPPLY AND CONSERVATION ALTERNATIVES FOR POWER GENERATION,
Oak Ridge National Lab., TN.
B. F. Hobbs.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84016443. Price codes: A06-PC in papercopy, A01-MF in microfiche. Electric Power Research Institute Report EPRI-P--3647, August 1984. 90 p, 13 fig, 17 tab, 79 ref, append. DOE Contract DE-AC05-840R21400. Research Project TPS80-723.

Descriptors: *Water supply, *Water conservation, *Water management, *Cooling water, *Model studies, *Electric powerplants, *Texas, Industrial water, Prediction, Cost analysis, Irrigation, Utilities, Water supply development.

National studies of water-energy conflicts have concluded that in several regions of the U.S., electric utilities may be unable to acquire enough water to support evaporative cooling in new power plants. Yet such studies cannot provide definitive findings, because data on nontraditional water supplies, such as rights transfers and groundwater, are unavailable on a national scale. The purpose of this research is to develop and apply a spatial linear program for comparing the cost and availability of a range of water sources within a region with the expense of dry and wet/dry cooling. To demonstrate the applicability of the approach, the model is used to calculate water supply and demand balances in the Texas Gulf region for the years 2000 and 2030. Surface and groundwater, potential transfers from irrigated agriculture, and sewage plant effluent are all considered. Contrary to the conclusions of previous studies, the solutions show that based on State of Texas projections of water supply and demand, the region is unlikely to require significant amounts of conventional dry or wet/dry cooling over the next fifty years. The model runs also indicate that few benefits would result in the year 2000 from development of advanced cooling methods, but that by the year 2030, advanced methods could yield significant cost savings for the region. These conclusions may not apply to other regions in the U.S., because hydrologic and institutional conditions differ from state to state. Therefore, before more definitive conclusions can be made about the desirability of dry cooling, other regions should also be investigated. (Author's abstract)
W87-07016

ANALYSIS OF DAILY WATER USE IN NINE CITIES,
Texas Univ. at Austin. Center for Research in Water Resources.
D. R. Maidment, S. P. Miaou, D. N. Nvule, and S. G. Buchberger.
Technical Report No. CRWR-201, February 1985. 67 p, 15 fig, 9 tab, 42 ref.

Descriptors: *Water use, *Texas, *Florida, *Pennsylvania, *Air temperature, *Municipal water, *Water conservation, *Rainfall, *Model studies, Mathematical models, Forecasting, Prediction.

Transfer functions are used to model the short-term response of daily municipal use to rainfall and air temperature variations. Daily water use data from nine cities are studied, three cities each from Texas, Florida, and Pennsylvania. It is demonstrated that the dynamic response of water use to rainfall and air temperature is similar across the cities within each state; in addition, the responses of the Texas and Florida cities are very similar to one another while the response of the Pennsylvania cities is different, more sensitive to air temperature and less to rainfall than the Texas or Florida cities. There appears to be no impact of city size on the response functions except that a small city has an inherent randomness in its water use data that is averaged out in a large city. The response of water use to rainfall depends first on the occurrence of rainfall and second on its magnitude. The occurrence of a rainfall more than 0.05 in/day causes a drop in the seasonal component of water use one day later that averages 38% for the Texas cities, 42% for the Florida cities, and 7% for the Pennsylvania cities. In Austin, Texas, a spatially averaged rainfall series shows a clearer relationship with water use than does rainfall data from a single gage; the drop in seasonal use in response to rainfall is constant at 19% of seasonal use when rainfall is up to 0.1 in/day, rises continuously to 45% of seasonal use when rainfall is 0.6 in/day and is constant thereafter. There is a nonlinear response of water use to air temperature changes with no response for daily maximum air temperatures between 40 F and 70 F, an increase in water use with air temperature beyond 70 F; above 85-90 F water use increases 3-4 times more per degree than below that limit in Texas and Florida. The change in water use per degree change in air temperature during rainless periods is approximately 1.5 times larger than the average response considering both rainless and rainy periods. The model resulting from these studies can be used for daily water use forecasting and water conservation analysis. (Author's abstract)
W87-07019

INPUT SUBSTITUTION AND DEMAND IN THE WATER SUPPLY PRODUCTION PROCESS,
Western Kentucky Univ., Bowling Green. Dept. of Economics.
H. Y. Kim, and R. M. Clark.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 239-244, February 1987. 6 tab, 15 ref.

Descriptors: *Water demand, *Water supply, *Model studies, *Costs, *Economic aspects, Mathematical models, Mathematical equations, Capacity, Water delivery, Capital, Energy, Labor, Water production.

The structure of input demand for U.S. water utilities is analyzed by estimating a translog cost function. An important feature of the model includes the multiproduct specification of the water supply production process. Operating variables are also specified to include capacity utilization and service distance, which are considered important for delivery of water supply. Results show that capital is a substitute for both energy and labor, but that no strong substitution possibilities exist between energy and labor. Energy is an input which requires intensive use in water production. Small utilities are found to enjoy economies of scale. Capacity utilization and service distance are found to have significant effects on input demand. (Author's abstract)
W87-07105

PROJECTED INCREASES IN MUNICIPAL WATER USE IN THE GREAT LAKES DUE TO CO2-INDUCED CLIMATIC CHANGE,
Canadian Climate Centre, Downsview (Ontario).
S. J. Cohen.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 91-101, February 1987. 4 fig, 8 tab, 14 ref.

Descriptors: *Climatic effects, *Water demand, *Urban water use, *Great Lakes, *Model studies, Basins, Water use, Carbon dioxide, Water supply, Climates, Regional analysis.

Two scenarios of CO2-induced climatic change are used to estimate changes in water use for a number of municipalities in the Great Lakes region of Canada and the United States. Both scenarios, based on General Circulation Models produced by the Goddard Institute for Space Studies (GISS) and Geophysical Fluid Dynamics Lab (GFDL), project warmer temperatures for the region. Using regression models based on monthly potential that annual per capita water use will increase by a small amount, which will probably have only a marginal effect on water supplies in the Great Lakes basin. This method could also be used to assess the potential impacts of CO2-induced climatic change on water use by the agriculture and power sectors, as well as the effectiveness of water policy initiatives, such as price changes. More work is needed to project water use during peak periods (warm dry spells), which may occur more frequently in a 2 x CO2 climate in this region. (Author's abstract)
W87-07184

OPTIMAL WATER ALLOCATION IN THE LAKES BASIN OF NICARAGUA,
Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba (Costa Rica).
C. G. Huete.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 121-126, February 1987. 3 fig, 4 tab, 3 ref.

Descriptors: *Water allocation, *Nicaragua, *Water demand, *Lakes Basin, *Water resources development, Lake Managua, Lake Nicaragua, Water transfer, Irrigation, Economic aspects.

The water resources of Nicaragua are largely undeveloped and distributed unequally throughout the nation. In addition, there is a significant geographical imbalance between the abundant water supply in the Atlantic Basin and the less abundant supply in the Pacific Basin which accounts for most of the water demand. The Lakes Basin, comprising Lakes Managua and Nicaragua, could be manipulated to solve the imbalance. A scheme has been proposed to transfer water from Lake Nicaragua to Lake Managua and, subsequently, direct water from each lake for irrigation and hydroelectric generation. The scheme was designed to maximize economic benefits and requires environmental impact analysis. (Author's abstract)
W87-07187

WATER CONSERVATION METHODS IN URBAN LANDSCAPE IRRIGATION: AN EXPLORATORY OVERVIEW,
Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 3D.
W87-07191

FORECASTING WATER USE ON FIXED ARMY INSTALLATIONS WITHIN THE CONTIGUOUS UNITED STATES,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
J. F. Langowski.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as AD-A145 739, Price codes: A09 in paper copy, A01 in microfiche. 181 p, 4 fig, 29 tab, 120 ref, 4 append.

Descriptors: *Forecasting, *Water use, *Water management, *Model studies, Data interpretation, Data acquisition, Water supply.

This study ascertains the status of selected water planning activities on Army installations and explores the possibility of integrating available data, measurement techniques and water use forecasting concepts into an improved water requirement model for operative consideration by Army installation planners and managers. The first question studied was concerned with gathering and analyzing information that would provide a broad perspective on what installation planners are doing to prepare for potential water supply problems expected to occur by the turn of this century. Analysis of average costs for water utility operations, maintenance and repair established that combined average costs are increasing significantly in real dollars and are likely to continue to rise, particularly on posts where aging system components will need replacement. Existing procedures and planning practices of 86 installations were assessed and the results indicate that better planning guidelines are needed in three areas: water requirement forecasting, water shortage contingency planning and procedural assessment of potential water conservation measures. The second research question focused on the formulation of an improved planning method to estimate installation peacetime water requirements. Analysis of the total building gross floor area of all structures on an Army post determined that three statistically significant sectors of water use composed of groups of specific building categories can be identified: a community service and support sector; a military activity sector; and a research and utility support sector. (Lantz-PTT)
W87-07302

ASSESSMENT OF SELECTED LEGAL/INSTITUTIONAL CONSTRAINTS TO WATER CONSERVATION IN THE WESTERN STATES,
Teknekron Research, Inc., Berkeley, CA.
For primary bibliographic entry see Field 6E.
W87-07305

ECONOMIC EVALUATION OF CONSERVATION CONCEPTS FOR MUNICIPAL WATER SUPPLY SYSTEMS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 3D.
W87-07421

WATER QUALITY DEPENDENT WATER USES IN PUGET SOUND.
JRB Associates, Inc., Bellevue, WA.
For primary bibliographic entry see Field 5G.
W87-07426

ECONOMICS OF WATER ALLOCATION TO INSTREAM USES IN A FULLY APPROPRIATED RIVER BASIN: EVIDENCE FROM A NEW MEXICO WILD RIVER,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Economics and Agricultural Business.
F. A. Ward.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 381-392, March 1987. 2 fig, 5 tab, 57 ref.

Descriptors: *Model studies, *River basins, *Water allocation, *Water use, *New Mexico, *Wild rivers, *Economic aspects, Streamflow, Recreation, Surveys, Competing use, Instream flow.

In fully appropriated multiple-use river basins, a major potential competitor for a share of water may be publicly sponsored appropriations to supplement low streamflows for fish, wildlife, and recreation, which generates economic values not revealed in the marketplace. Based on a survey of instream recreationists on New Mexico's Rio Chama a travel cost model is developed to identify the potential recreation demand for instreams flows. A discrete optimal control model is formulated that solves for the intraseasonal allocation of reservoir releases which maximizes the yearly value of instream recreation benefits, net of values of competing uses in the basin. Results indicate that in New Mexico, reservoir releases which augment low streamflows can return gross recreation benefits in the range of $900 to $1100 per acre-foot (ac ft) of water consumed (1 ac ft = 1233 cu m). This compares to a $40/ac ft cost of using the water. Consequently, results strongly support the hypothesis of potential economic payoff from public investments in and management of instream flow reservations. (Author's abstract)
W87-07469

PRIME WATER MARKETS FLOW IN DIVERGENT DIRECTIONS,
For primary bibliographic entry see Field 6E.
W87-07542

GROWING CLEAN WATER NEEDS CONFRONT A CAPITAL CRUNCH,
For primary bibliographic entry see Field 5G.
W87-07544

6E. Water Law and Institutions

VALUE OF INSTITUTIONAL CHANGE IN ISRAEL'S WATER ECONOMY,
Hebrew Univ. of Jerusalem (Israel).
E. Sadan, and R. Ben-Zvi.
Water Resources Research WRERAQ, Vol. 23, No. 1, p 1-8, January 1987. 3 fig, 4 tab, 15 ref.

Descriptors: *Water resources development, *Model studies, *Israel, *Water supply development, *Nonstructural alternatives, Social aspects, Computer models, Institutions, Regional analysis, Economic aspects, Costs.

Water resource development is commonly associated with hardware components of the water supply system and not the existing institutions and established arrangements. The social cost of the institutional arrangements existing in Israel's water economy were examined, the potential of institutional changes was quantified, and their capacity to compete with projects aimed at the development of 'new' resources was assessed. The situation was examined against situations which might have evolved should institutional barriers be relaxed using a linear programming model of Israel's water supply and farming systems in the various regions and social strata. The findings demonstrate the low economic cost of the institutional alternative relative to that provided through new resource development. (Author's abstract)
W87-06811

CITY/SUBURB VIEWS ON GROUNDWATER ISSUES,
Appalachian State Univ., Boone, NC. Dept. of Political Science.
For primary bibliographic entry see Field 5G.
W87-06860

POLITICS OF GROUND WATER PROTECTION,
National Association of Conservation Districts, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-06861

WASTEWATER TREATMENT ACQUISITION STRATEGY FOR TEXAS COMMUNITIES,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 5D.
W87-07020

UK INTERPRETATION AND IMPLEMENTATION OF THE EEC SHELLFISH DIRECTIVE,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5G.
W87-07081

IMPLEMENTATION STRATEGIES FOR AGRICULTURAL AND SILVICULTURAL NONPOINT SOURCE POLLUTION CONTROL IN CALIFORNIA AND WISCONSIN,
Wisconsin Univ.-Stevens Point. Coll. of Natural Resources.
For primary bibliographic entry see Field 5G.
W87-07189

REGULATORY NEEDS FOR TESTS TO PREDICT THE BEHAVIOUR OF ENVIRONMENTAL CHEMICALS.
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W87-07242

IMPLEMENTATION OF RCRA AND SUPERFUND BY THE U.S. EPA - THE STATE'S PERSPECTIVE,
Vermont State Agency of Environmental Conservation, Montpelier.
R. A. Valentinetti.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 1-8.

Descriptors: *Legislation, *Resource Conservation and Recovery Act, *Superfund, *Waste disposal, *Water quality control, *New Jersey, *Love Canal, Landfills, Injection wells, Hazardous wastes.

With the passage of the Clean Air and Water Acts in the early 70's, Congress unwittingly enhanced the problems associated with solids and hazardous waste disposal. Hazardous sludges produced by the treatment of air and water emissions and wastes that would have been discharged to streams and rivers prior to the Clean Water Act were disposed of in landfills, lagoons, underground injection wells, etc. To further complicate this situation, the unforeseen legacy of America's industrialization was beginning to manifest itself in the form of Love Canal, the Kin-buc landfill in New Jersey, and other old waste disposal sites. To close the loop of environmental regulation, in 1976 Congress enacted the Resource Conservation and Recovery Act (RCRA) to deal with the ongoing problems of hazardous waste management. In order to provide for the cleanup of closed or inactive hazardous waste disposal sites and emergency spill response, in 1980 Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), more commonly called Superfund. This chapter is a discussion of the effect on the states of EPA's implementation of these two Acts. (See also W87-07243) (Lantz-PTT)
W87-07244

CONFLICTS AND HAZARDOUS WASTE MANAGEMENT - THE ENVIRONMENTALIST'S VIEWPOINT,
Cleveland State Univ., OH.
For primary bibliographic entry see Field 5E.
W87-07245

PUBLIC PARTICIPATION IN OHIO EPA'S SOLID AND HAZARDOUS WASTE PROGRAM,
For primary bibliographic entry see Field 5E.
W87-07246

HAZARDOUS WASTE MANAGEMENT - AN INDUSTRY PERSPECTIVE,
Republic Steel Corp., Cleveland, OH.
For primary bibliographic entry see Field 5E.
W87-07248

PARTNERSHIP APPROACH TO HAZARDOUS WASTE FACILITY SITING,
Ohio Environmental Council, Inc., Columbus.
For primary bibliographic entry see Field 5E.
W87-07249

SOLID WASTE FACILITY SITING - COMMUNITY ASPECTS AND INCENTIVES,
Battelle Columbus Labs., OH.
For primary bibliographic entry see Field 5E.
W87-07250

NEW YORK STATE INDUSTRIAL MATERIALS RECYCLING PROGRAM,
New York State Environmental Facilities Corp., Albany.
P. T. Simpson.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 195-207, 3 fig, 2 tab, 5 ref.

Descriptors: *New York, *Recycling, *Legislation, *Waste disposal, Legal aspects, Hazardous wastes, Industrial wastes, Wastewater treatment, Wastewater reuse.

Many efforts have been made in the field of regulation of hazardous waste management facilities in New York State and, to complete the overall concept of a sound, total program, the Governor signed in law on July 31, 1981, a bill entitled the New York State Industrial Materials Recycling Act. This is a major program to encourage industries to reduce, recycle and reuse industrial materials including industrial solid waste and industrial hazardous waste. A many faceted program, it not only initiated activities in the waste exchange field, but encouraged the development of information exchange, technology transfer and technical assistance. The law, which is an amendment to the Public Authorities Law of the State of New York, specifically mandates the New York Sate Environmental Facilities Corporation,a public benefit corporation, to establish a comprehensive program to assist industries that generate industrial materials by: (1) encouraging the reduction, recovery and recycling of these materials; (2) providing industries with technical information and assistance; and (3) encouraging the exchange of materials. (See also W87-07243) (Lantz-PTT)
W87-07259

HAZARDOUS WASTE LAND DISPOSAL REGULATIONS - AN ENVIRONMENTALIST PERSPECTIVE,
Environmental Defense Fund, Washington, DC.
For primary bibliographic entry see Field 5E.
W87-07263

EPA'S LAND DISPOSAL REGULATIONS - WASTE DISPOSAL INDUSTRY'S PERSPECTIVE,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5E.
W87-07266

MANUFACTURERS' WARRANTIES ON HAZARDOUS WASTE DISPOSAL EQUIPMENT,

Morrison, Hecker, Curtis, Kuder and Parrish.
S. A. Reigel.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 373-379, 19 ref.

Descriptors: *Waste disposal, *Hazardous wastes, *Legal aspects, *Warranties, Regulations, Economic aspects.

The Uniform Commercial Code (UCC) has been adopted as the law of commerce in 49 of the 50 states (Louisiana excepted) and for all intents and purposes it is the same law in each state. The UCC is divided into 11 articles; Article 2 contains the law of sales of 'goods'. Hazardous waste disposal equipment falls within the UCC definition of 'goods'. In this paper, the terms 'equipment' or 'hazardous waste disposal equipment' will be used instead of the term 'goods'. When a buyer purchases hazardous waste disposal equipment from a seller, the buyer may be entitled to the protection of two separate and distinct types of warranties respecting the quality and performance of the equipment: (1) express warranties; and (2) implied warranties. If the seller breaches an express or implied warranty, the buyer is entitled to damages. In general, the measure of damages for breach of warranty is the difference between the value of the equipment accepted and the value the equipment would have had if it had been as warrantied. In addition to these 'direct' damages, the buyer may also be entitled to 'incidental' and 'consequential' damages. Incidental damages are those miscellaneous expenses incurred by the buyer which result from the seller's breach, such as cost of inspection; receipt, transportation, care and custody of the goods; long distance telephone calls; etc. If buyer and seller wish, they may 'liquidate' damages at the inception of the sales contract. In this event, buyer and seller will pre-agree on a reasonable amount which will be paid by seller to buyer in the event a warranty is breached. (See also W87-07243) (Lantz-PTT)
W87-07275

FEDERAL AND STATE ENFORCEMENT OF HAZARDOUS WASTE LAWS,
Baker, Hostetler and Patterson, Cleveland, OH.
For primary bibliographic entry see Field 5G.
W87-07276

GENERATOR LIABILITY UNDER SUPERFUND,
Eastman and Smith.
For primary bibliographic entry see Field 5G.
W87-07277

ENVIRONMENTAL LAW AND CONTRACTOR LIABILITY,
Smith and Schnacke, Dayton, OH.
J. W. Blattner, and E. A. Hogan.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 405-413.

Descriptors: *Legal aspects, *Liability, *Environmental law, *Contractors, Regulations, State jurisdiction, Federal jurisdiction, Cleanup operations.

The potential liabilities of a contractor range the full span from ancient common law doctrines to the most recent federal and state statutory and regulatory enactments (i.e., Superfund). A vast amount of remedial work needs to be performed at the heretofore unattended waste disposal sites throughout the nation. The extent of a contractor's potential liability will depend not only on statutory and regulatory pronouncements, the specifics of the waste site and the range of services the contractor agrees to provide, but also with the contracting entity with which it deals. Before agreeing to participate in any cleanup operation, a contractor must carefully examine all the potential pitfalls. (See also W87-07243) (Lantz-PTT)
W87-07278

ASSESSMENT OF SELECTED LEGAL/INSTITUTIONAL CONSTRAINTS TO WATER CONSERVATION IN THE WESTERN STATES,
Teknekron Research, Inc., Berkeley, CA.
R. J. Glickstein, R. Heimbichner, S. Rosenbaum, and D. Downing.
(NTIS availability statement) PB87 183 158/A5 A016 A01Department of the Interior, Office of Water Research and Technology, April 1981. 350 p, 5 fig, 11 tab, 129 ref, append. Contract 14-34-0001-9452.

Descriptors: *Legal aspects, *Water conservation, *Institutional constraints, Jurisdiction, Water rights, Water transfer.

A study was made of four legal/institutional constraints to water conservation in the agricultural sector of the seventeen western states. The objectives of the study were to: (1) identify major perceived legal/institutional constraints to water conservation in the western states and summarize what has been reported in the literature regarding each; (2) determine how these perceived obstacles operate in each of the western states (through an investigation of statutes, judicial decisions, and administrative procedures); (3) determine the extent to which each perceived obstacle represents an actual constraint to efficient water use; and (4) offer a set of recommendations aimed at mitigating the actual legal/institutional constraints, if any, in the western states. After conducting a preliminary literature review and holding discussions with water resource administrators and experts throughout the West, the study team decided to concentrate on four discrete elements of the legal framework for water rights (of surface waters) and their associated institutional arrangements. These elements are: (1) the difficulty of securing rights to salvaged water; (2) the requirement of beneficial use; (3) prohibitions on temporary water transfers and water banking; and (4) the forfeiture of appropriative rights by reason of nonuse. (Lantz-PTT)
W87-07305

PRIME WATER MARKETS FLOW IN DIVERGENT DIRECTIONS,
R. J. Hannan.
Engineering News - Record ENREAU, Vol. 217, No. 22, p 23, November 1986. 2 tab.

Descriptors: *Economic aspects, *Water use, *Water management, *Construction, *Water supply development, *Contracts, Water resources development, Wastewater facilities, Sewer systems, Irrigation, Flood control, Powerplants, Hydroelectric plants, Port facilities, Legal aspects, Legislation.

The United States water construction market is reviewed as of September, 1986. Although flagging water use and control construction markets are expected to improve following President Reagan's approval of the Water Resources Development Act, his earlier veto of the Clean Water Act reauthorization may stretch out any broad upturn until next spring. Water use and control contracts fell for the second consecutive month in September, leaving total awards through the month with only a 2% lead over last year's volume. Sewer line and waste treatment plant markets are giving way to reductions in federal pollution control grants, trailing last year's three-quarter mark by 8% and 17%, respectively. Industrial waste treatment jobs are doing better, having added almost $18 million in new awards in September. A surge in new flood control, irrigation, port development, and hydroelectric dam jobs offset a 9% monthly decline in new September earthwork and waterway development projects. Most of the year's cumulative gain in new harbor repair and shoreline maintenance work through the first nine months came in the third quarter; these categories topped last year's nine-month volume by 15% and 35%, respectively. (Doria-PTT)
W87-07542

6F. Nonstructural Alternatives

VALUE OF INSTITUTIONAL CHANGE IN ISRAEL'S WATER ECONOMY,
Hebrew Univ. of Jerusalem (Israel).
For primary bibliographic entry see Field 6E.
W87-06811

FLOODWAY DELINEATION AND MANAGEMENT,
Department of Housing and Urban Development, Washington, DC.
D. E. Jones, and J. E. Jones.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 228-242, March 1987. 9 ref.

Descriptors: *Floodways, *Runoff, *Flood plain management, Delineation, Risk assessment, Hazards, Risks, Public participation.

A definition of the term 'floodway' is suggested, considering historical perspective, and discussing often-overlooked floodway functions that should influence floodway delineation. Rationales are presented for value judgments that might affect floodway delineation. Also emphasized is the importance to local governments of thorough assessment of multiple land and water needs and risks before making floodway delineation determinations. (Author's abstract)
W87-07197

WETLAND VALUATION: POLICY VERSUS PERCEPTIONS,
Eastern Michigan Univ., Ypsilanti.
For primary bibliographic entry see Field 2H.
W87-07441

6G. Ecologic Impact Of Water Development

QUALITY AND UNCERTAINTY ASSESSMENT OF WILDLIFE HABITAT WITH FUZZY SETS,
Maryland Univ., College Park. Dept. of Civil Engineering.
B. M. Ayyub, and R. H. McCuen.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 1, p 95-109, January 1987. 5 tab, 44 ref.

Descriptors: *Wildlife habitats, *Assessment, Vegetation effects, Computers.

A method of assessing the quality of wildlife habitat based on the judgment of experts is proposed. The method uses the concepts of fuzzy sets and systems and can be applied to describe the wildlife habitat in an area where planned project activities will affect vegetative patterns. It permits the evaluation of small parts as well as the whole project area. The method can also generate other information required in preparing environmental impact assessments and can be easily programmed on computers. The main advantages of the method are that it provides for incorporating judgment uncertainty into the decision and has the ability to show the uncertainty in the final outcome, that is, the quality of wildlife habitat. (Authors' abstract)
W87-06713

COMPUTERIZED ASSESSMENT OF ENVIRONMENTAL IMPACTS IN AN ESTUARINE SYSTEM,
Texas Univ. at Austin. Center for Research in Water Resources.
T. E. Capone, and N. E. Armstrong.
CRWR Paper 181, EHE 8102, May 1981. Technical Report. 80 p, 13 fig, 12 tab, 28 ref, append.

Descriptors: *Automation, *Ecological effects, *Estuaries, *Environmental effects, *Oysters, *Computer programs, Data interpretations, Databases, Bioassay, Mapping.

A computerized procedure for assessing the environmental impact of modifications to an estuarine environment is outlined and tested. The test case assesses the effect of freshwater inflow reduction upon a non-mobile species, the American bay oyster (Crassostrea virginica). Although the test case is relatively simple, the required steps for performing a computerized impact assessment are

presented and demonstrated. The first step, data management, is accomplished through utilization of a database management system, SYSTEM 2000. Procedures for defining, loading, updating and retrieving data from the database are described. The next step, impact calculation, is accomplished utilizing a bioassay-based transformation function, which relates parameter concentration to mortality and statistical techniques which compare baseline and modified regimes. Analysis of the various levels of impact is accomplished utilizing a computer mapping program SYMAP. Generalized computer methods which input previously generated data to the SYMAP program are described as are methods which control the entire impact calculation and display process. These methods allow for calculation of impact under various levels of change once the necessary framework is established. (Author's abstract)
W87-06941

DREDGED-MATERIAL OCEAN DUMPING: PERSPECTIVES ON LEGAL AND ENVIRONMENTAL IMPACTS,
National Wildlife Federation, Washington, DC.
For primary bibliographic entry see Field 5E.
W87-06981

EFFECTS OF FLOW ALTERATIONS ON TROUT, ANGLING, AND RECREATION IN THE CHATTAHOOCHEE RIVER BETWEEN BUFORD DAM AND PEACHTREE CREEK,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. M. Nestler, J. Fritschen, R. T. Milhous, and J. Troxel.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report E-86-10, August 1986. Final Report. 107 p, 20 fig, 13 tab, 13 ref, 3 append.

Descriptors: *Ecological effects, *River flow, *Chattahoochee River, *Buford Dam, *Peachtree Creek, *Georgia, Trout, Fishing, Recreation, Water quality.

Increasing flows in the Chattahoochee River to meet the water supply needs of the metropolitan Atlanta area will affect all current uses of the river that are flow related. Some of the effects will be beneficial and some detrimental. However, flow modifications in the channel to provide for water demand can be made that are consistent will all important present uses of the river. The following general recommendations are designed both to provide for increased flow in the river and to optimize as many uses of the river as possible: (1) release higher flows on weekdays and lower flows on weekends (1,000 cfs or lowest flow that does not result in detrimental water temperatures for trout); (2) operate Morgan Falls Dam primarily as a run-of-the-river project with some provision for special releases for weekend angling and recreation; (3) operate Buford Dam, proposed reregulation dam, and Morgan Falls Dam as a system to provide for water supply, recreation, and fish habitat between Morgan Falls and Peachtree Creek; (4) concentrate stocking of juvenile brown trout to wide shoal areas where optimum habitat occurs at discharges closer to the mean annual discharge than at nonshoal reaches of the river; (5) if a reregulation dam is constructed, consider either maintaining water levels high enough to prevent dewatering of Bowmans Island Shoals, or releasing flows from Buford Dam as the pool within the reregulation dam drops below the level required for use of the boat ramp immediately downstream from Buford Dam. A combination of these two approaches to prevent dewatering of Bowmans Island Shoals may be needed based upon seasonal water quality considerations; and (6) perform studies on the effects of a reregulation dam on downstream water quality. (Lantz-PTT)
W87-07006

HANDBOOK ON RESERVOIR RELEASES FOR FISHERIES AND ENVIRONMENTAL QUALITY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. M. Nestler, C. H. Walburg, J. F. Novotny, K. E. Jacobs, and W. D. Swink.
Available from the National Technical Information Service, Springfield, VA 22161. Instruction Report E-86-3, July 1986. Final Report. 95 p, 28 fig, 44 ref.

Descriptors: *Reservoir releases, *Environmental effects, *Fisheries, *Reservoir operation, Hydroelectric plants, Water temperature, Channel morphology, Reservoir fisheries, Flow profiles, Water quality.

As part of its role in the development of water resources, the Corps of Engineers (CE) operates reservoir projects to fulfill authorized project purposes such as flood control, water supply, navigation, power generation, and recreation. The operation of reservoir projects can cause considerable alteration in preimpoundment conditions. The storage and release of impounded water not only floods the river upstream from the dam but also modifies the immediate downstream reaches, or tailwater. Project operation may modify preimpoundment flows, channel morphology, temperatures, and concentrations of dissolved gases and other water quality conditions in the tailwater and thereby significantly alter or disturb the downstream aquatic ecosystem. Development of water resources by the CE through the operation of reservoir projects, in a manner that is consistent with environmental quality, can be achieved by avoiding or ameliorating the negative downstream effects of reservoir project operation. This instruction report identifies and discusses many of the downstream environmental quality effects of general reservoir project operation, peaking hydropower operation, and flood control operation. Individual design and operation elements are identified, when possible, and the specific environmental effects of each are detailed under topic headings. Some of the topics addressed in this handbook include the effects of daily and weekly minimum low flows, effects of fall drawdown, effects of highly fluctuating flows, and relative effects of surface versus deep release. Each topic is defined and discussed; recommendations are presented which, in many cases, will alleviate the detrimental environmental quality effects of reservoir project operation. (Lantz-PTT)
W87-07008

PEN REARING AND IMPRINTING OF FALL CHINOOK SALMON,
Seattle National Fishery Research Center, WA.
For primary bibliographic entry see Field 8I.
W87-07014

EXTERNAL THREATS: THE DILEMMA OF RESOURCE MANAGEMENT ON THE COLORADO RIVER IN GRAND CANYON NATIONAL PARK, USA,
Arizona Univ., Tucson.
R. R. Johnson, and S. W. Carothers.
Environmental Management EMNGDC, Vol. 11, No. 1, p 99-107, January 1987. 2 fig, 2 tab, 19 ref.

Descriptors: *Colorado River, *Water resources Management, *Grand Canyon National Park, *Glen Canyon Dam, Recreation, Flow, Parks, Dams.

The United States Congress established Grand Canyon National Park in 1919 to preserve for posterity the outstanding natural attributes of the canyon cut by the Colorado River. In some cases National Park Service attempts to maintain Grand Canyon's natural environment have been thwarted by activities outside the park. One of the most obvious external threats is Glen Canyon Dam, only 26 km upstream from the park boundary. Constructed in 1963, this gigantic dam has greatly altered the physicochemical and biological characteristics of 446 km of the Colorado River in Grand Canyon National Park. The river's aquatic ecosystem has been greatly modified through the loss of indigenous species and the addition of numerous exotics. The riparian ecosystem has been less modified, with addition of a few exotics and no loss of natives. The great dilemma now faced by park managers is that, after 20 years of managing resources along a river controlled by Glen Canyon Dam, the Bureau of Reclamation has proposed major changes in operational procedures for the dam. Scientists and mangagers from the National Park Service, Bureau of Reclamation, and cooperating federal and state resource management agencies are using a systems analysis approach to examine the impact of various Colorado River flow regimes on aquatic, riparian, and recreational parameters in the park. This approach will help in the development of management alternatives designed to permit the most efficient use of that river's natural resources without their destruction. (Author's abstract)
W87-07086

EXTERNAL THREATS AND INTERNAL MANAGEMENT: THE HYDROLOGIC REGULATION OF THE EVERGLADES, FLORIDA, USA,
East Texas State Univ., Commerce. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-07087

GREENHOUSE EFFECT, SEA LEVEL RISE, AND COASTAL DRAINAGE SYSTEMS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 4C.
W87-07196

DOLORES ARCHAEOLOGICAL PROGRAM: ANASAZI COMMUNITIES AT DOLORES: EARLY SMALL SETTLEMENTS IN THE DOLORES RIVER CANYON AND WESTERN SAGEHEN FLATS AREA,
Dolores Archaeological Program, CO.
T. A. Kohler, W. D. Lipe, and A. E. Kane.
Available from the National Technical Information Service, Springfield, Virginia 22161 as PB86-236247. Price codes: A99-PC in papercopy, E04-MF in microfiche. Bureau of Reclamation, Denver, Colorado. May 1986. 913 p, 31 ig, 211 tab, 401 ref, 21 append. Contract 8-07-40-S0562.

Descriptors: *Dolores Project, *Archaeology, *Environmental effects, Social impact, Cultural resources, Resources development.

This volume reports on a series of investigations in the Dolores River canyon and the western Sagehen Flats area of the Dolores Project. Included in the collection are an overview of the Grass Mesa Locality (with a summary of Dolores Archaeological Program systematics), the results of the 1979-80 Grass Mesa Locality Testing Program, and 6 site reports that describe excavations undertaken between 1979 and 1983. The excavated sites reported include: (1) LeMoc Shelter, which exposed 5 Anasazi occupations between A.D. 750 and 950; (2) Prince Hamlet, a Pueblo I habitation occupied between A.D. 720-840; (3) Hamlet de la Olla, with a primary occupation between A.D. 780 and 810 and a later field house manifestation; (4) Kin Tl'iish, with a primary occupation between A.D. 760-850, A.D. 850-975, and A.D. 1050-1200 periods; (5) Pozo Hamlet, a pithouse and associated features with construction traits of both Basketmaker III and Pueblo I periods, between A.D. 600 and 780; and (6) Poco Tiempo, a Basketmaker III site dating between A.D. 690 and 730. (Author's abstract)
W87-07337

DOLORES ARCHAEOLOGICAL PROGRAM: RESEARCH DESIGNS AND INITIAL SURVEY RESULTS,
Dolores Archaeological Program, CO.
A. E. Kane, W. D. Lipe, T. A. Kohler, and C. K. Robinson.
Available from the National Technical Information Service, Springfield, Virginia 22161 as PB86-236239. Price codes: A21 in papercopy, AO1 in microfiche. Bureau of Reclamation, June 1986. 475 p, 63 fig, 130 tab, 552 ref, 16 append. Contract 8-07-40-S0562.

Descriptors: *Dolores Project, *Archaeology, Social impact, Cultural resources, Environmental effects, Resources development.

Contained here is a collection of the basic planning and management documents for the Dolores Archaeological Program. The first chapter introduces the volume and provides an evaluation of the effectiveness of Dolores Archaeological Program planning efforts. Operational problems encountered by the program are also discussed. The second chapter is the 'Dolores Project Cultural Resources Mitigation Design', the primary document guiding program conceptual management. The two major parts of this chapter are the research design, a general structure of inquiry for conducting investigations, and the implementation design, a presentation of methods for acquiring the information needed to answer questions posed in the research design. Four subsequent chapters provide discussion of approaches to specific data sets. These four chapters - the midlevel research designs for survey, reductive technologies, additive technologies, and environmental archaeology - provide the basis for the analyses of settlement patterns and material culture. The final four chapters are a selection of reports focusing on Dolores Archaeological Program survey efforts. Two reports discuss the results of inventory survey and two reports present the results of probability surveys. Included in these survey chapters are discussions of data collection, settlement behavior, site location analysis, and methods of estimating site populations. Specific locality estimates of site population based on probability sampling techniques are provided; a study of rock art in the Dolores Project area is also summarized. (Author's abstract)
W87-07338

RESULTS OF PALEONTOLOGICAL MONITORING AT A BUREAU OF RECLAMATION/ BUREAU OF INDIAN AFFAIRS EROSION STABILIZATION PROJECT: BRONCO POINT, AMERICAN FALLS RESERVOIR, SOUTHEASTERN IDAHO,
Idaho Museum of Natural History, Pocatello.
S. J. Miller, and W. A. Akersten.
Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 as PB86-213337. Price codes: A02-PC in papercopy, A01-MF in microfiche.Paleontology Reports No. 1, Idaho Museum of ural History, Pocatello, Idaho 83209, January 1986. 13 p, 2 fig, 9 ref, append. Bu Rec Purchase Order 5-PG-14-08130.

Descriptors: *Paleontology, *Erosion control, *American Falls Reservoir, *Idaho, *Archaeology, Monitoring, Fossils, Snake River, Gastropods, Fish, Horses, Mammoths, Sloths.

In late summer, 1985, the staff of the Idaho Museum of Natural History, under a contract with the Bureau of Reclamation, monitored an erosion control construction project at the fossil-rich American Falls Reservoir in southeastern Idaho. Ninety hours of field monitoring at Bronco Point yielded 52 fossils representing the 8+ Pleistocene genera. Bison (c.f. latifrons) and camel (Camelops sp.) skeletal elements dominate the collection, with horse, mammoth, and sloth well represented. Most specimens were recovered during a pre-construction surface inspection. Approxmately 250 lbs. (dry weight) of clay, grab-sampled during construction augering operations, were taken to the Idaho Museum of Natural History and water-screened for microfauna. Several hundred small gastropods and one small fish pharyngeal tooth were recovered, but not yet identified. This sampling took advantage of the opportunity to recovver fossils and characterize the aquatic environment of the late Pleistocene Snake River. (Author's abstract)
W87-07340

TEST EXCAVATION OF SITE 10-VY-520, CASCADE RESERVOIR, IDAHO,
Eastern Oregon State Coll., La Grande. Museum of Anthropology.
M. E. W. Jaehnig.
Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 as PB86-213121. Price codes: A03-PC in papercopy, A01-MF in microfiche. Project Report Number 1, December 1985. 29 p, 6 fig, 4 tab, 7 ref, 10 plates. Bu Rec Purchase Order 5-PG-10-10700.

Descriptors: *Cascade Reservoir, *Idaho, *Excavation, *Archaeology, History, West Mountain, Fossils, Paleontology.

Site 10-VY-520 is located on the west shore of Cascade Reservoir, at the foot of West Mountain. Eastern Oregon State College excavated 48 shovel test holes to an average depth of 1.2 m and four 1x1 m test pits to an average depth of 0.75 m. Only one lithic flake was recovered. A dark, buried depositional layer was found during excavations, and an attempt has been made to put this layer into a framework of regional depositional and, thus, climatic history. The site was evaluated in terms of its cultural significance within the limits of National Register criteria. The site is not considered to meet the eligibility criteria for inclusions in the National Register of Historic Places. (Author's abstract)
W87-07341

ARCHAEOLOGICAL SITE TESTING AND EVALUATION IN THE LONETREE RESERVOIR AREA, GARRISON DIVERSION UNIT, SHERIDAN AND WELLS COUNTIES, NORTH DAKOTA,
Ethnoscience, Billings, MT.
K. Deaver.
Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 as PB86-245842. Price codes: A07-PC in papercopy, A01-MF in microfiche. December 1983. 133 p, 13 fig, 7 tab, 42 ref, pend. Bu Rec Work Order 3-CS-60-00260.

Descriptors: *Archaeology, *Lonetree Reservoir, *Garrison Diversion Unit, *North Dakota, Sheridan County, Wells County, History, Tipi rings, Cairns, Artifacts.

Archaeological site testing and evaluations were conducted at a sample of the sites in the proposed Lonetree Reservoir. A photo recordation of a National Register (NR) property was also completed. The original contract called for testing and evaluation of 11 sites, but field decisions and site lumping led to changes in the scope of work and ultimately 8 sites (32SH108, SH110, SH117, SH118, SH138, SH159, WE107 and WE117) were tested and evaluated. Seven of the 8 prehistoric sites were shallow stone feature sites with tipi rings, cairns or both. Site 32SH118 is a lithic scatter in a plowed field. All sites were transit mapped; all features were mapped. All sites were tested with small (3-8 sq m) samples in line with the NDSHPO Draft Guidelines for tipi ring sites. Three sites (32SH110, SH117 and WE107) are recommended as potentially eligible to the NRHP as a result of the information potential in subsurface artifact remains and/or surface feature attributes. (Author's abstract)
W87-07342

STUDY OF FIVE HISTORIC CEMETERIES AT CHOKE CANYON RESERVOIR, LIVE OAK AND MCMULLEN COUNTIES, TEXAS,
Texas Univ. at San Antonio. Center for Archaeological Research.
A. A. Fox.
Available from the National Technical Information Service, Springfield, Virginia, 22161as PB84-244375. Price codes: A05 in paper copy, A01 in microfiche. Center for Archaeological Research, The University of Texas at San Antonio. Choke Canyon Series: Volume 9, 1984. 72 p, 21 fig, 2 tab, 43 ref, 3 append.

Descriptors: *Choke Canyon Reservoir, *Texas, *History, *Archaeology, Social impact.

From December 1981 to November 1982, archaeologists from the Center for Archaeological Research, the University of Texas at San Antonio, and the U.S. Bureau of Reclamation aided in relocation of five historic cemeteries at Choke Canyon Reservoir in Live Oak and McMullen Counties. Thirty-four graves were located, uncovered, recorded and removed to other cemeteries. During the process, descendants of the families involved provided valuable information on grave locations and identification. Observations were made which will be useful to other archaeologists engaged in similar projects. Information was compiled on customs and traditions of the people of the area in respect to death and burial. (Author's abstract)
W87-07366

ARCHAEOLOGICAL SURVEY OF PORTIONS OF THE BUFFALO LAKE NATIONAL WILDLIFE REFUGE, RAND COUNTY, TEXAS,
Bureau of Reclamation, Amarillo, TX. Southwest Region.
J. S. Hays.
Bureau of Reclamation, Amarillo, Texas. August 1986. 32 p, 2 fig, 2 tab, 12 ref, append.

Descriptors: *Archaeology, *Buffalo Lake, *Texas, Paleontology, Wild habitats.

A Bureau of Reclamation survey of portions of the Buffalo Lake National Wildlife Refuge in the Texas Panhandle was conducted in June 1983. The survey and subsequent visits recorded six new archaeological sites and revisited 19 previously recorded archaeological and two previously recorded paleontological sites. All of the sites are evaluated on the basis of new data, and management recommendations are offered. An inventory of all known cultural resources within the Buffalo Lake National Wildlife Refuge is provided. (Author's abstract)
W87-07390

7. RESOURCES DATA

7A. Network Design

REGIONAL GROUND-WATER-QUALITY NETWORK DESIGN,
Geological Survey, Sacramento, CA. Water Resources Div.
W. E. Templin.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 37-44, 2 fig, 3 tab, 12 ref.

Descriptors: *Groundwater quality, *Network design, *San Joaquin Valley, *California, Monitoring, Statistical analysis, Water pollution sources, Water sampling, Nonpoint source pollution.

The approach used in designing a regional network to monitor the complex groundwater quality conditions in the San Joaquin Valley, California is described. The potential exists for application of this method in other similar attempts to develop regional groundwater quality information. Existing data were used to design two regional networks - an 'ideal' network and an 'actual' network. The ideal network represents a goal for use in expanding monitoring efforts. The actual network approximates the ideal network with the constraint of primarily using wells that are already being monitored by someone for some purpose. Further inventories of monitoring networks and installation of some specialized monitoring wells will be needed. Use of statistical network analysis techniques is also needed to make network improvements. Following these actions, the actual network will more closely approximate the ideal network in providing information on groundwater quality trends, contaminant sources, prevention of future sources of contamination, monitoring well distributions, sampling frequencies, and constituents to be monitored. (See also W87-06850) (Author's abstract)
W87-06855

DESIGN OF AN EFFECTIVE MONITOR WELL NETWORK,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.

Group 7A—Network Design

G. M. Carlton, and R. Armstrong.
IN: Groundwater Contamination and Reclamation, Proceedings of a Symposium held in Tucson, Arizona, August 14-15, 1985. American Water Resources Association, Bethesda, Maryland. 1985. p 61-69, 5 fig, 1 tab.

Descriptors: *Monitoring, *Sampling, *Groundwater quality, *Network design, *Test wells, *Groundwater pollution, Water sampling, Piezometry, Water analysis.

A prerequisite for remedial action of groundwater contamination is to determine the extent, flow pattern, and distribution of contamination. Strategically placed monitor wells afford the required information. Well construction and sampling techniques for the investigation at an 8,500-acre site are described. The monitoring network consists of a system of multiple completion monitor wells which are clusters of small diameter water quality monitoring and water level monitoring piezometers placed in a single borehole. Drilling techniques used are casing hammer, for depths of 0 to 100 feet, and a combination of casing hammer and mud rotary, for depths over 100 feet. Three water quality monitoring piezometers are completed: one at the elevation presumed to contain chemicals; one in the next higher; and one in the next lower zone capable of transmitting water. Water level piezometers are completed between the water quality monitoring piezometers and give information on the rate of leakage that occurs when pumping during sampling. To obtain accurate data from samples, a suction side sample catcher (SSSC) was designed which uses a packer to minimize required pumping volume and to isolate the sample from disturbance from pumping activity. Testing of the SSSC has proven that it is reliable and efficient. (See W87-06850) (Author's abstract)
W87-06858

GUIDELINE CONSIDERATIONS FOR SELECTING ANALYTICAL METHODS AND FOR COST ANALYSIS ASSOCIATED WITH MONITORING WATERS ASSOCIATED WITH ALTERNATIVE FOSSIL FUEL TECHNOLOGIES,
Dalton-Dalton-Newport, Inc., Cleveland, OH.
For primary bibliographic entry see Field 5A.
W87-06872

INTRODUCTION TO COMPUTERS,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 7C.
W87-06966

SELECTING A COMPUTER AND SOFTWARE: A USER'S VIEWPOINT,
Wyoming Wastewater Treatment Plant, Grandville, MI.
For primary bibliographic entry see Field 7C.
W87-06967

WATER NETWORK ANALYSES,
Wade, Trim and Associates, Inc., Taylor, MI.
P. Shay.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 93-100, 2 fig, 4 ref.

Descriptors: *Network design, *Model studies, Computer models, *Water distribution, *Water management, Water supply, Computers, Design criteria.

The purpose of a water network analysis is to provide a master plan for the operation and development of the water distribution system. The system's ability to provide adequate flows and pressures throughout the service area is determined. Of equal importance is the development of the computer model that evaluates or predicts the system's response to unexpected system demands. Pipe sizes, system storage facilities, and high-service pumping can then be sized to be consistent with the goals set forth in the master plan rather than by reactions to isolated service requests throughout the service area. The degree to which the computer model and master plan become useful is inherently tied to the engineer's development of an accurate computer model and realistic design parameters. Great care must be exercised in collecting the data needed to define the distribution network and develop the computer model. The main responsibility lies in the ability to provide the engineer with a realistic Master Land Use Plan which defines the projected requirements of the water service area as accurately as possible. Based on the Master Water Plan, maintenance and capital improvement programs can be planned and executed with the confidence that the existing and future service area will be adequately served. (See also W87-06965) (Lantz-PTT)
W87-06974

COMPUTER AIDED MAPPING AND DESIGN,
Engineerng and Graphic Services, Inc., Oak Park, MI.
M. N. Kumra.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 101-115, 9 fig.

Descriptors: *Mapping, *Computer programs, *Design, *Wastewater treatment, *Water treatment, Graphical methods, Computers, Data interpretation, Process control, Wastewater management, Water management.

Digital cartography is a well established science and such data is used in many high-tech applications. Introduced here are the rudiments of a Computer Aided Design and Drafting (CADD) system. Hardware and software requirements of a CADD system for water and wastewater applications are reviewed. Also discussed are the concepts of computer aided mapping (and drafting) and retrieval of such information for management and other design applications. Once an interactive graphic system is established, the database of the distribution facilities supports many diverse applications. Work order processing can assist in the maintenance operations and plant accounting can become more efficient through the use of standard and demand report generation. A single master map system is maintained. Various map products are generated, eliminating the need for manually preparing numerous maps of different scales and symbologies. (See also W87-06965) (Lantz-PTT)
W87-06975

PRIORITIZING AREAS FOR STATEWIDE GROUNDWATER MONITORING,
Illinois State Water Survey Div., Champaign.
L. P. Le Seur, H. A. Wehrmann, S. C. Schock, and J. M. Shafer.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 113, No. 2, p 204-215, March 1987. 7 fig, 18 ref.

Descriptors: *Groundwater monitoring, *Hazardous materials, *Groundwater management, *Network design, *Aquifers, *Priorities, Illinois, Monitoring, Groundwater, Mapping, Computers.

A methodology for identifying and prioritizing areas in Illinois for monitoring of hazardous substances in groundwater is described. The criteria used to determine monitoring priorities are the density of hazardous substance-related commercial/industrial activity, the amount of current groundwater withdrawals for public water suppiy, the likelihood of future groundwater development through potential yield of sand and gravel and shallow bedrock aquifers, and the susceptibility of these aquifers to contamination. A computerized map overlay system is employed to differentiate prioritized areas throughout Illinois at a spatial scale of discrete United States Postal Service zip code units. (Author's abstract)
W87-07195

EVALUATION OF DATA REQUIREMENTS FOR GROUNDWATER CONTAMINANT TRANSPORT MODELING,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-07472

OPTIMIZATION OF SAMPLING LOCATIONS FOR VARIOGRAM CALCULATIONS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. W. Warrick, and D. E. Myers.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 496-500, March 1987. 3 fig, 2 tab, 8 ref. Western Regional Research Project W-155.

Descriptors: *Data requirements, *Optimization, *Variograms, *Distribution, *Sampling, *Variability, Dispersion, Computers, Estimating.

A method is presented and demonstrated for optimizing the selection of sample locations for variogram estimation. It is assumed that the distribution of distance classes is decided a priori and the problem therefore is to closely approximate the preselected distribution, although the dispersion within individual classes can also be considered. All of the locations may be selected or points added to an existing set of sites or to those chosen on regular patterns. In the examples, the sum of squares characterizing the deviation from the desired distribution of couples is reduced by as much as 2 orders of magnitude between random and optimized points. The calculations may be carried out on a micro-computer. Criteria for what constitutes best estimators for variogram are discussed, but a study of variogram estimators is not the object of this paper. (Author's abstract)
W87-07479

7B. Data Acquisition

RAPID METHODS FOR DETERMINING NUTRIENTS IN LIVESTOCK MANURES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W87-06644

AUTOMATED SYSTEM FOR MEASUREMENT OF EVAPOTRANSPIRATION FROM CLOSED ENVIRONMENTAL GROWTH CHAMBERS,
Agricultural Research Service, Mississippi State, MS.
J. M. McKinion, and H. F. Hodges.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1825-1828, November-December 1985. 7 fig, 6 ref.

Descriptors: *Growth chambers, *Computer programs, *Computers, *Automation, *Evapotranspiration, *Measuring instruments, *SPAR units, Performance evaluation, Data acquisition, Transpiration, Plant growth.

The design and operation of a computer hardware and software system with pressure sensors that provides for the automatic acquisition of transpiration data from controlled environment plant growth chambers (called Soil-Plant-Atmosphere-Research, SPAR, units) and storage of collected data in an online database is described. The system also provides for automatic error checking of collected data and preliminary analysis of data. The computer hardware consists of a superminicomputer and a microcomputer networked together. The software system consists of data acquisition and analysis software written in ANSI 1977 FORTRAN. Although measurements were taken every 15 min, longer measurement periods can be used. The system was very reliable and accurate over crop growing periods up to five months. (Alexander-PTT)
W87-06645

NEAR INFRARED REFLECTANCE SOIL MOISTURE METER,
Tokyo Univ. of Agriculture and Technology (Japan).
Y. Kano, W. F. McClure, and R. W. Skaggs.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1852-1855, November-December 1985. 6 fig, 17 ref.

Descriptors: *Measuring instruments, *Soil water, *Soil water meter, *Field tests, *Infrared reflectance, Design criteria, Performance evaluation, Soil types, Clays, Loam, Estimating.

The gravimetric method is still the most widely used method for determining the water content of soils. However, it often takes hours to make gravimetric determinations making the method undesirable for field measurements. The design and performance of a near infrared reflectance moisture meter is discussed. The meter is small, hand-held and takes reflectance measurements using an integrating cylinder and two narrow band interference filters, at 1.80 and 1.94 micron to get the moisture reading. Standard error of estimate was found to be + or - 1.9% moisture units over a range from 5 to 35% on clay and loam soils. (Alexander-PTT)
W87-06649

WIND TUNNEL STUDY OF SPRINKLER CATCH-CAN PERFORMANCE,
Franzoy, Corey Engineers and Architects, Phoenix, AZ.
For primary bibliographic entry see Field 3F.
W87-06666

PORTABLE FLOW METERING DEVICE FOR FURROW IRRIGATION STUDIES,
Nebraska Univ., Clay Center. South Central Research and Extension Center.
D. E. Eisenhauer, C. A. Borcher, and D. G. Watts.
Transactions of the ASAE TAAEAJ, Vol. 28, No. 6, p 1986-1988, November-December 1985. 1 fig, 1 tab, 7 ref.

Descriptors: *Measuring instruments, *Furrow irrigation, *Flow meters, Calibrations, Gate valves, Flow, Irrigation, Orifices.

A portable flow metering device was developed for use in furrow irrigation studies where gated pipe is used for water delivery. The clamp-on device utilizes commercially available orifices. Calibration of the metering device revealed that if the same discharge coefficient is used for all eight of the orifices tested, the uncertainty in measurement is less than 5% of actual flow. The uncertainty increases to slightly over 5% of actual flow if a partially open gate valve is located 12 diameters upstream from the orifice. An additional and useful characteristic of the device is that the desired flow can be established rapidly. (Author's abstract)
W87-06670

RUNOFF PREDICTION USING REMOTE SENSING IMAGERY,
Draper Engineering Research, Atlanta, GA.
For primary bibliographic entry see Field 2A.
W87-06687

OPTIMAL TESTING FREQUENCY FOR DOMESTIC WATER METERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
R. R. Noss, G. J. Newman, and J. W. Male.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol.113, No. 1, p 1-14, January 1987. 4 fig, 5 tab, 13 ref, 1 append.

Descriptors: *Water meters, *Water measurement, *Measuring instruments, Maintenance, Maintenance costs, Domestic water use, Utilities.

Most utilities meter water delivered to customers to calculate the consumer's water bills. Unless domestic meters are tested and maintained, the unmetered water due to meter inaccuracies can be a significant portion of the system's total unaccounted-for water. Testing meters too frequently may result in spending more money on meter maintenance than is recovered in terms of unmetered water lost. Testing meters too infrequently can result in large revenue losses due to excessive under-registration by meters in service. A procedure was developed to determine the optimal testing frequency for 5/8-inch meters. The objective was to minimize the cost to the utility, including the cost of the meter testing program itself and the cost (revenue loss) of the water not registered due to meter inaccuracy. Water losses due to both working, but inaccurate, meters and failed meters were accounted for. The rate of decline of meter accuracy with age was found to be the most significant influence on the optimal testing frequency. (Authors' abstract)
W87-06706

WATER AND SEDIMENT SAMPLER FOR PLOT AND FIELD STUDIES,
Environmental Protection Agency, Washington, DC. Water Quality Office.
S. A. Dressing, J. Spooner, J. M. Kreglow, E. O. Beasley, and P. W. Westerman.
Journal of Environmental Quality JEVQAA, Vol. 16, No. 1, p 59-64, January-March 1987. 6 fig, 4 tab, 21 ref.

Descriptors: *Sampling devices, *Field studies, *Design criteria, *Performance evaluation, *Sediments, Flow rates, Correlation analysis, Soil types, Statistics, Monte Carlo simulation, Runoff.

The design and performance characteristics of a flush-type sampling device for plot and field studies are described. The sampler is weld-constructed and requires excavation and water conveyance for installation. It operates with no external power supply and collects consistently a known fraction of water and sediment passing through it. In laboratory tests, the sampler collected 2.65% (number of data points (n) = 54, standard deviation (s) = 0.0040) of all water passing through it at average flow rates ranging from 18 to 196 L.min. Sample volumes ranged from 0.75 to 18.7L. Correlation analysis showed that sampling percentage was independent of flow rate (n = 40, correlation coefficient = r = -0.04) over the range tested. In other laboratory tests, 30 sampling runs with inflow rates and total sediment concentrations ranging from 35 to 182 L/min and 252 to 1410 mg/L, respectively, showed that the ratios of waste to sample sediment concentrations were approximately one for total sediment (1.001), and for the sand (1.097), silt (1.008), and clay (1.020) fractions. Sand and clay ratios were shown to be statistically independent of total sediment concentration, but silt (r = 0.30, n = 30) and total sediment (r = 0.44, n = 30) ratios increased slightly with increasing total concentration. Monte Carlo simulation was performed to illustrate the suitability of the flush-sampler for field and plot runoff studies. Simulation results indicated that for runoff estimates measurement error would exceed 10% with 33% probability for triplicate plots, but with only 16% probability in five plot studies. Additional simulation considering only measurement error associated with the sampler shows that the minimum number of paired samples required to detect sediment loss reductions of 50, 25, and 10% is 3, 4, and 16, respectively. (Author's abstract)
W87-06724

DIRECT DETERMINATION OF CADMIUM IN NATURAL WATERS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITHOUT MATRIX MODIFICATION,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5A.
W87-06731

FLUORIDE ION-SELECTIVE ELECTRODE IN FLOW INJECTION ANALYSIS: PART 3. APPLICATIONS,
Hahn-Meitner-Inst. fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W87-06735

ASSESSMENT OF REFERENCE ELECTRODES FOR USE IN DETERMINING THE PH OF ACIDIC, POORLY-BUFFERED WATERS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. Midgley.
Atmospheric Environment ATENBP, Vol. 21, No. 1, p 173-177, January 1987. 1 fig, 1 tab, 20 ref.

Descriptors: *Performance evaluation, *Acid rain, *Reference electrodes, *Measuring instruments, *Hydrogen ion concentration, *Buffered media, Solutions, Acids, Electrodes, Accuracy.

Tests for screening out reference electrodes unsuitable for pH measurements in poorly-buffered media involve observations of bias, signal noise and change of signal between stirred and quiescent solutions of dilute (typically .0001 N) strong acid. Eighteen electrodes of varying junction configuration, electrical resistance and bridge-solution leak rate were subjected to these tests: only three met practical targets for all three parts of the test, with two near-misses. If only bias is considered, ten electrodes were within the limit of 0.05 pH error. Characteristics such as junction configuration, electrical resistance and leak-rate were of little value in predicting an electrode's performance, empirical testing being the only way of increasing confidence in the pH measurements. (Author's abstract)
W87-06747

DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AQUEOUS SYSTEMS BY MEMBRANE INLET MASS SPECTROMETRY,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5A.
W87-06761

EXTRACTION AND DETERMINATION BY GAS CHROMATOGRAPHY OF S,S,S-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) IN FISH AND WATER,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5A.
W87-06789

ALUMINUM SPECIATION: A COMPARISON OF FIVE METHODS,
Clemson Univ., SC. Dept. of Computer Engineering.
For primary bibliographic entry see Field 2K.
W87-06800

PREDICTION OF PH ERRORS IN SOIL-WATER EXTRACTORS DUE TO DEGASSING,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W87-06801

SINGLE COLUMN ION CHROMATOGRAPHY: III. DETERMINATION OF ORTHO-PHOSPHATE IN SOILS,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
For primary bibliographic entry see Field 2K.
W87-06802

SENSITIVE COLORIMETRIC METHOD FOR THE QUANTITATION OF SELENITE IN SOIL SOLUTIONS AND NATURAL WATERS,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
For primary bibliographic entry see Field 5A.
W87-06803

AUTOMATED TECHNIQUE FOR FLOW MEASUREMENTS FROM MARIOTTE RESERVOIRS,
Geological Survey, Menlo Park, CA.
J. Constantz, and F. Murphy.
Soil Science Society of America Journal SSSJD4, Vol. 51, No. 1, p 252-254, January-February 1987. 3 fig, 6 ref.

Descriptors: *Measuring instruments, *Mariotte reservoirs, *Automation, *Flow measurement,

*Flowmeters, Water level, Pressure, Infiltration, Evaporation, Performance evaluation, Monitoring.

The mariotte reservoir supplies water at a constant hydraulic pressure by self-regulation of its internal gas pressure. Automated outflow measurements from mariotte reservoirs are generally difficult because of the reservoir's self-regulation mechanism. An automated flow meter specifically designed for use with mariotte reservoirs is described. The flow meter monitors changes in the mariotte reservoir's gas pressure during outflow to determine changes in the reservoir's water level. The flow measurement is performed by attaching a pressure transducer to the top of a mariotte reservoir and monitoring gas pressure changes during outflow with a programming data logger. Using a simple linear relation between reservoir gas pressure and water-level changes with time, the data logger converts the transducer signal into outflow-flux values. To demonstrate the usefulness of the new technique, two constant-head experiments are described that have vastly different flux ranges and time durations. The first experiment was a 1-h infiltration run in which infiltration rates dropped from 0.6 to 0.2 cm/min. The second experiment was a 3-week evaporation experiment in which the evaporation rate ranged from 1.0 to 3.0 cm/d. Results indicate that the automated flow measurement technique performed well when compared to a manual sight-tube technique for flux measurements; the difference between the two methods was never more than 9% for the infiltration experiment and 5% for the evaporation experiment. The advantages of the new technique over previously available automated flow measurement techniques include: (i) the ability to rapidly record a large range of fluxes without restricting outflow, and (ii) the ability to accurately average the pulsing flow, which commonly occurs during outflow from the mariotte reservoir. (Author's abstract)
W87-06809

THREE-MINUTE ANALYSIS OF CHLORIDE, NITRATE, AND SULFATE BY SINGLE COLUMN ANION CHROMATOGRAPHY,
Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
For primary bibliographic entry see Field 5A.
W87-06810

DESIGN OF AN EFFECTIVE MONITOR WELL NETWORK,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 7A.
W87-06858

ELECTROCHEMICAL HYDROGEN PATCH PROBE CORRELATED TO CORROSION RATE IN A SLIGHTLY SOUR WATER FLOOD,
Petrolite Instruments, Houston, TX.
R. Dexter.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 15-22, 6 fig, 1 tab, 3 ref.

Descriptors: *Measuring instruments, *Industrial water, *Hydrogen path probe, *Corrosion, Water quality control, Hydrogen, Monitoring, Pipes, Diffusion.

An externally mounted electrochemical cell was recently developed that can be patched onto the outside of steel pipes and vessels. This probe monitors the amount of hydrogen diffusing through the steel walls. The hydrogen path probe (HPP) was mounted on a slightly sour water flood line 9.1440 m (30 ft) upstream of a corrosion coupon rack. Real time hydrogen current levels are compared to weekly weight loss corrosion measurements for a period of six months. Areas of agreement and disagreement are discussed. The probe data indicated a good probability that the high corrosion excursions of May and June are due to an oxygen incursion. If this conclusion is correct, then the HPP system indicated the upset in April one month prior to the corrosion coupons. (See also W87-06888) (Lantz-PTT)
W87-06890

MOBILE WELLHEAD ANALYZER FOR THE DETERMINATION OF UNSTABLE CONSTITUENTS IN OIL-FIELD WATERS,
Fort Detrick, Frederick, MD.
S. H. Hoke, and A. G. Collins.
IN: Water for Subsurface Injection, Proceedings of the Second Symposium sponsored by the ASTM Committee D-19 on Water, Ft. Lauderdale, Florida, January 28-29, 1980. 1981. p 34-48, 7 fig, 6 tab, 10 ref.

Descriptors: *Measuring instruments, *Mobile well head analyzer, *Water analysis, *Brines, *Industrial wastewater, Pollutant identification, Oil fields, Oil industry, Hydrogen ion concentration, Conductivity, Carbon dioxide, Sulfides.

A brine analyzer was designed that measures pH, redox potential (Eh), oxygen, conductivity, sulfide ion (S(2-)), HCO3(-), CO3(2-), and carbon dioxide in oil field water at the wellhead. When oil field brine samples are collected in the field and transported to the laboratory for analysis, many of the unstable constituents change in concentration. The amount of change depends on the sampling method, sample storage, ambient conditions, and the amounts of the constituents in the original sample. Thus, an analysis of the brine at the wellhead is necessary to obtain reliable data. (See also W87-06888) (Author's abstract)
W87-06892

AQUATIC MACROPHYTON SAMPLING: AN OVERVIEW,
Breedlove Associates, Inc., Orlando, FL.
For primary bibliographic entry see Field 2H.
W87-06900

AQUATIC MACROPHYTON FIELD COLLECTION METHODS AND LABORATORY ANALYSES,
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 2H.
W87-06902

BIOSTATISTICAL ASPECTS OF MACROPHYTON SAMPLING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 2H.
W87-06903

DEVELOPMENT AND USE OF THE WATERWAYS EXPERIMENT STATION'S HYDRAULICALLY OPERATED SUBMERSED AQUATIC PLANT SAMPLER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
B. M. Sabol.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 46-57, 3 fig, 1 tab, 25 ref.

Descriptors: *Measuring instruments, *Samplers, *Design criteria, *Limnology, *Hydraulic machinery, *Aquatic plants, *Sampling devices, Quantitative methods, Biomass.

A quantitative submersed aquatic plant sampler that can rapidly collect plants from a known area at any depth was developed for the U.S. Army Engineer Aquatic Plant Control Research Program. The design and use of this hydraulically operated cylindrical sampler and an improved second generation square-shaped sampler are discussed. Quantitative data are presented that compare these samplers to each other and to other sampling techniques including mechanical harvesters. There are substantial differences between submersed aquatic plant standing crop and biomass estimates produced by the different sampling techniques tested. Greatest differences between estimates were observed between the WES cylindrical sampler and estimates produced by the WES square sampler, the manual clipping technique performed by scuba divers, and the harvestable standing crop estimation technique. Factors contributing to these differences probably include operational and handling procedures in addition to sampler design features, such as size and shape of the sampler. Plant condition factors, such as structure and density, are also assumed to influence the measurements obtained. Based on the limited data available, it appears that there may be systematic biases associated with the different submersed aquatic plant biomass estimation techniques, which could invalidate direct comparisons between different techniques. It is therefore recommended that systematic comparison tests be conducted to evaluate and document the various submersed aquatic plant sampling techniques. These tests should be conducted at sites that have several different plant species, plant heights, structure and density, and different substrate types.(See also W87-06899) (Lantz-PTT)
W87-06905

OSBORNE SUBMERSED AQUATIC PLANT SAMPLER FOR OBTAINING BIOMASS MEASUREMENTS,
University of Central Florida, Orlando. Dept. of Biological Sciences.
J. A. Osborne.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 58-68, 8 fig, 2 tab, 9 ref.

Descriptors: *Aquatic plants, *Sampling devices, *Biomass, *Submerged plants, *Osborne sampler, *Measuring instruments, *Limnology, Water columns, Seasonal variation.

The Osborne submersed aquatic plant sampler was designed to obtain biomass samples from the water column and sediment of lakes and streams. The sampler, which is operated by winch and cable from a pontoon boat, is easily operated to obtain a sufficient number of samples within a limited time frame (one day) for applying statistical methods. Mean biomass estimates (kilograms per meter squared), percent frequency of occurrence, seasonal biomass trends, and seasonal or annual mean biomass distribution of submersed aquatic vegetation can be calculated from data collected with the sampler. The sampler has been used in aquatic plant studies to determine the distribution, ecology, and effect of control methodologies for submersed plant species. Several study lakes may be visited per sampling day because of the ease of transporting the sampler. (See also W87-06899) (Author's abstract)
W87-06906

USE OF AERIAL REMOTE SENSING IN QUANTIFYING SUBMERSED AQUATIC MACROPHYTES,
Tennessee Valley Authority, Chattanooga. Mapping Services Branch.
D. S. Andrews, D. H. Webb, and A. L. Bates.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 92-99, 1 fig, 1 tab, 19 ref.

Descriptors: *Remote sensing, *Mapping, *Aerial photography, *Aquatic plants, *Macrophytes, *Limnology, *Tennessee Valley Authority, Reservoirs.

Aerial photographs of several Tennessee Valley Authority (TVA) reservoirs are taken each year to determine acreages of the dominant species of submersed aquatic macrophytes. Described here are methods used in obtaining and interpreting the photographs. For operational work, the TVA uses large-scale color photographic prints made from a color-negative film. Although more expensive than black-and-white (BW) film, the color film allows better discrimination of submersed species of aquatic plants. While false-color (color-infrared) film has been widely used for mapping and monitoring emergent and wetland plant communities, it

is less desirable than true-color film for delineating and mapping submersed plants. Scales of 1:7,200 and 1:12,000 are commonly used and provide the detail and resolution needed for accurate photointerpretation of several submersed macrophyte species. The TVA is also experimenting with an airborne thermal line scanner for mapping aquatic plants. The imagery from the system can in some cases be used to delineate the limits of colonies of Eurasian water milfoil according to differencesin surface water temperatures. (See also W87-06899) (Author's abstract)
W87-06910

USE OF SMALL-FORMAT AERIAL PHOTOGRAPHY IN AQUATIC MACROPHYTON SAMPLING,
Breedlove Associates, Inc., Orlando, FL.
B. W. Breedlove, and W. M. Dennis.
IN: Ecological Assessment of Macrophyton: Collection, Use, and Meaning of Data. A Symposium Sponsored by ASTM Committee D-19 on Water, Fort Lauderdale, Florida, January 15-16, 1983. 1984. p 100-111, 4 tab, 11 ref.

Descriptors: *Remote sensing, *Limnology, *Aerial photography, *Aquatic plants, *Macrophytes, *Sampling, Photography, Plant populations, Water quality, Species composition.

Standard 35- and 70-mm low altitude aerial photography provides a low cost, effective means for sampling aquatic macrophyte communities. Both color and color infrared (CIR) film have been used successfully. A haze filter should be used with color film, and a Wratten 12 or 15 filter should be used with color infrared. Adequate water penetration is provided by color film in waters with high turbidity and suspended matter while CIR film may be preferable in low turbidity waters. Ground coverage tables provide scale and areal coverage in tabular form at various altitudes, focal lengths, and appropriate time intervals to ensure 60% stereo overlap. Various cameras and lens combinations can be used; however, a 28-mm lens with the 35-mm single-lens reflex (SLR) camera and a 40- or 80-mm lens with a 70-mm camera have proven very effective and allow maximum areal coverage at lower altitudes. This flexibility allows photo missions to be flown below cloud bases in less than optimum conditions while still obtaining good quality photography. When combined with appropriate ground surveys and knowledgeable photointerpretation, small-format photography can provide detailed documentation of the areal extent of macrophyte communities and, in many instances, of species composition as well. (See also W87-06899) (Author's abstract)
W87-06911

FRAMEWORK FOR THE COMPLEMENTARY USE OF MATHEMATICAL MODELS AND MICROCOSMS IN ENVIRONMENT ASSESSMENT,
Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 7C.
W87-06926

MANUAL OF ANALYTICAL METHODS FOR WASTEWATERS (OIL SHALE RETORT WATERS).
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06929

SEPARATION OF AMMONIA FROM ORGANIC NITROGEN USING TUBULAR MICROPOROUS POLYTETRAFLUOROETHENE MEMBRANES: NONOSMOTIC DISSOLVED-GAS DIALYSIS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06931

CARBON ANALYSIS: UV-PEROXYDISULFATE OR HIGH-TEMPERATURE OXIDATION COUPLED WITH COULOMETRIC TITRATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06932

NITROGEN: KJELDAHL AND COMBUSTION/CHEMILUMINESCENCE,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06934

CHEMICAL OXYGEN DEMAND (COD): COLORIMETRIC AND TITRIMETRIC QUANTITATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06935

MICROBIAL BIOMASS: QUANTITATION AS PROTEIN,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W87-06936

POTENTIAL USE OF GPR IN ASSESSING GROUNDWATER POLLUTION IN PARTIALLY AND FULLY SATURATED SOILS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
J. J. Bowders, R. M. Koerner, and A. E. Lord.
IN: Role of the Unsaturated Zone in Radioactive and Hazardous Waste Disposal, Ann Arbor Science Publishers, Ann Arbor, Michigan. 1983. p 179-194, 8 fig, 1 tab, 17 ref. EPA Cooperative agreement CR-804763.

Descriptors: *Ground probing radar, *Remote sensing, *Groundwater quality, *Saturated soils, *Groundwater pollution, Water quality control, Radar, Electromagnetic waves, Geohydrology, Pore water, Soil water.

Electromagnetic (EM) methods have been used to probe subsurface soil and rock materials since the 1920's. Most of this activity has been by mining geologists and engineers and has centered about prospecting for minerals and other natural resources. These efforts are generally associated with searches over large distances and to great depths (on the order of hundreds of meters). Geotechnical and environmental engineers, on the other hand, have need to investigate subsurface details over limited distances and at shallow depths (on the order of a few meters). This paper concentrates on the technique utilizing pulsed radio frequency waves, commonly called Ground Penetrating Radar or Ground Probing Radar (GPR). On a qualitative basis it is seen that high salt concentrations in soil pore fluid significantly attenuates GPR signals. Furthermore, this attenuation, as evidenced by the lightness of the GPR traces, increases with increasing degrees of saturation. In an attempt to quantify the process, the bands between the soils' surface and the bottom of the box were counted and plotted. The bands which are due to the transmitted pulses and their reflections, might be a tool which can be used to determine the presence of high ion content pollutants in soil pore water at various degrees of saturation including the fully saturated case. Such a sweeping statement, however, must be further explored beyond the limits of this feasibility study. (See also W87-16947) (Lantz-PTT)
W87-06959

EVALUATION OF A TEFLON HELIX LIQUID-LIQUID EXTRACTOR FOR CONCENTRATION OF TRACE ORGANICS FROM WATER INTO METHYLENE CHLORIDE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5A.
W87-07053

MIXING CUP AND THROUGH-THE-WALL MEASUREMENTS IN FIELD-SCALE TRACER TESTS AND THEIR RELATED SCALES OF AVERAGING,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2F.
W87-07067

DEVELOPMENT OF A TOTAL SUSPENDED SOLIDS STANDARD,
International Paper Co., Mobile, AL. Erling Riis Research Center.
For primary bibliographic entry see Field 5A.
W87-07102

DYNAMICS OF PARTIAL ANAEROBIOSIS, DENITRIFICATION, AND WATER IN A SOIL AGGREGATE: EXPERIMENTAL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Theoretical Production Ecology.
For primary bibliographic entry see Field 2G.
W87-07137

DEVICE FOR SAMPLING THE MUD-WATER INTERFACE IN EUTROPHIC LAKES AND BOGS FOR RESIDUE ANALYSIS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
M. Noble, P. C. Oloffs, R. So, J. Yee, and F. Yuen.
Journal of Environmental Science and Health JPFCD2, Vol. 21, No. 5, p 359-373, October 1986. 3 fig, 8 ref.

Descriptors: *Sampling devices, *Sediment-water interfaces, *Water quality, *Pollutant identification, *Measuring instruments, *Sediment sampler, *Pesticides, Ponds, Eutrophic Lakes, Water pollution sources.

A tubular device was developed making it possible to obtain layered samples of loosely aggregated, flocculant material from bogs or eutrophic lakes. The samples are up to 50 cm long and 15 cm in diameter. The sampler is free from protruberances and intact, layered samples can be obtained. The tubular part of the sampler is about 85 cm long, the walls of the lower 25-cm portion harboring a pneumatic closing mechanism which is controlled from above the water surface. An extendible handle for manipulating the sampler and for guiding it into place is fastened to the upper end of the sampling tube. The performance and the operation of the sampler in the field are described. (Author's abstract)
W87-07138

UV-EXTINCTIONS OF AQUATIC HUMIC ACIDS: ITS DEPENDENCE ON THE ELEMENTAL COMPOSITION,
Gesamthochschule Essen (Germany, F.R.). Inst. fuer Physikalische und Theoretische Chemie.
For primary bibliographic entry see Field 2K.
W87-07144

PREPLANTING SOIL MOISTURE USING PASSIVE MICROWAVE SENSORS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, M. E. Hawley, and P. E. O'Neill.
Water Resources Bulletin WARBAQ, Vol. 23, No. 1, p 11-19, February 1987. 6 fig, 1 tab, 14 ref.

Descriptors: *Soil water, *Microwave sensors, *Measuring instruments, *Planting management, Texas, Crop yield, Irrigation efficiency, Root zone, Remote sensing, Model studies, Mapping, Irrigation, Agriculture.

Accurate assessment of preplanting soil moisture conditions is necessary for good agricultural management, and can have a significant influence on crop yield in the Texas Panhandle region. The Texas High Plains Underground Water Conservation District invests considerable time and money in developing a soil moisture deficit map each year in the hopes of achieving optimal use of irrigation

water. Microwave sensors are responsive to surface soil moisture and, if used in this application, can provide timely and detailed information on root zone soil moisture. For this reason, an experiment was conducted in 1984 to evaluate the potential of aircraft-mounted passive microwave sensors. Microwave radiometer data were collected over a 2700 sq km area near Lubbock, Texas, with a processed resolution of 0.32 sq km. These data were ground registered and converted to estimates of soil moisture using an appropriate model and land cover and soil texture information. Analyses indicate that the system provides an efficient means for mapping variations in soil moisture over large areas. (Author's abstract)
W87-07176

COMPARISON OF TWO METHODS FOR DETERMINING COPPER PARTITIONING IN OXIDIZED SEDIMENTS,
Geological Survey, Menlo Park, CA.
S. N. Luoma.
Marine Chemistry MRCHBD, Vol. 20, No. 1, p 45-59, October 1986. 4 fig, 1 tab, 29 ref, 2 append.

Descriptors: *Model studies, *Copper, *Oxidized sediments, *Comparison studies, Prediction, Extraction, Distribution, Sediments, Heavy metals, Estuaries, Estimating.

Model estimations of the proportion of Cu in oxidized sediments associated with extractable organic materials show some agreement with the proportion of Cu extracted from those sediments with ammonium hydroxide. Data were from 17 estuaries of widely differing sediment chemistry. The modelling and extraction methods agreed best where concentrations of organic materials were either in very high concentrations, relative to other sediment components, or in very low concentrations. In the range of component concentrations where the model predicted Cu should be distributed among a variety of components, agreement between the methods was poor. Both approaches indicated that Cu was predominantly partitioned to organic materials in some sediments, and predominantly partitioned to other components (most probably iron oxides and manganese oxides) in other sediments, and that these differences were related to the relative abundances of the specific components in the sediment. Although the results of the two methods of estimating Cu partitioning to organics correlated significantly among 23 stations from the 17 estuaries, the variability in the relationship suggested refinement of parameter values and verification of some important assumptions were essential to the further development of a reasonable model. (Author's abstract)
W87-07215

DETERMINATION OF ALKALINITIES OF ESTUARINE WATERS BY A TWO-POINT POTENTIOMETRIC TITRATION,
Liverpool Univ. (England). Dept. of Oceanography.
C. M. G. Van Den Berg, and H. Rogers.
Marine Chemistry MRCHBD, Vol. 20, No. 3, p 219-226, January 1987. 1 fig, 2 tab, 13 ref.

Descriptors: *Potentiometric titration, *Analytical methods, *Alkalinity, *Coastal waters, Seawater, Titration, Electrodes, Calibrations, Hydrogen ion concentration, Measuring instruments, Estuaries.

Gran plots of titrations of seawater with acid are straight lines after protonation of all weak acids when ion-pairing is taken into account. This property is used to calibrate the pH electrode and to determine the endpoint of what is essentially a two-point alkalinity titration of the sample. First the initial sample pH is measured; then a standard addition of acid is made giving a pH near 3.2 (pH sub 1); a further acid addition is made giving a pH near 2 (pH sub 2). The slope of the electrode response and the total alkalinity are calculated from pH sub 2 and pH sub 1. The advantages of this method are that no separate calibrations are necessary; no corrections for variations in activity coefficients are needed because pH values are obtained on the seawater pH scale; and the instruments used for the determinations are very simple. The standard deviation of the alkalinity determination of seawater by the proposed technique was + or - 0.10%. (Author's abstract)
W87-07220

PICOMOLAR MERCURY MEASUREMENTS IN SEAWATER AND OTHER MATERIALS USING STANNOUS CHLORIDE REDUCTION AND TWO-STAGE GOLD AMALGAMATION WITH GAS PHASE DETECTION,
Connecticut Univ., Groton. Marine Sciences Inst.
For primary bibliographic entry see Field 5A.
W87-07221

PREDICTING IONIC STRENGTH FROM SPECIFIC CONDUCTANCE IN AQUEOUS SOIL SOLUTIONS,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 2K.
W87-07222

GROUNDWATER MONITORING SYSTEMS - ONLY AS GOOD AS THE WEAKEST LINK,
ERM-Midwest, Inc., Columbus, OH.
For primary bibliographic entry see Field 2F.
W87-07253

POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY.
American Society for Testing and Materials, Philadelphia, PA.
A Symposium Sponsored by ASTM Committee D-19 on Water , ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. 235 p. Edited by R. W. Lane and Gerard Otten.

Descriptors: *Instrumentation, *Symposium, *Water quality control, *Measuring instruments, *Powerplants, *Industrial water, Monitoring, Economic aspects, Ion chromatography, Spectrometry, Electrodes, Conductivity, Gravimetry.

This book is based on a symposium which was organized to present the need for power plant instrumentation in the measurement of high-purity water quality and to disclose the latest developments in this instrumentation. Present water treatment techniques in high-pressure electric utility plants are complex, and monitoring the water quality assumes a very important role in ensuring continuous and efficient operation of these power plants. Proper and efficient monitoring of water quality is necessary to avoid expensive plant outages (at reported costs of $1,000,000 per day) that can occur if the plant chemistry is allowed to vary from specified limits, possibly because of inadequate instrumentation. The papers in this book disclose the problems involved in monitoring the water quality of high-purity water and provide information on new instrumentation and the refinements that have been developed. The information contained here should be helpful to engineers designing the instrumentation for new plants, for those charged with the responsibility of updating instrumentation for plants that do not have adequate monitoring of water quality to ensure uninterrupted and economical maintenance-free operation. Since as many as seven or more different general methods of measurement are described here, a full picture of the available instrumentation has been provided. Techniques employing various methods of measurement, such as ion chromatography, atomic absorption spectrometry, specific-ion electrodes, ion-exchange columns, electrical conductivity, a gravimetric method, and differential pulse polarography, are covered. Discussions on methods of sampling, desired points of sampling, and other details are included. (See also W87-07280 thru W87-07299) (Lantz-PTT)
W87-07279

MONITORING POWER PLANT WATER CHEMISTRY,
Babcock and Wilcox Co., Alliance, OH. Alliance Research Center.
F. J. Pocock.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 8-10.

Descriptors: *Powerplants, *Water quality control, *Water analysis, *Measuring instruments, Chemical analysis, Dissolved oxygen, Hydrazine, Hydrogen ion concentration, Conductivity, Chromatography.

The principle objective of cycle water conditioning in power plants is the maintenance and repair of the protective oxide film on the water side material surfaces of cycle components, water piping, and steam piping. An equally important objective is the prevention of damaging or efficiency-reducing accumulation of deposits on the energy conversion surfaces. To accomplish this job of corrosion and deposition prevention, it is increasingly necessary to have full-time and real-time monitoring of trace cations, anions, and dissolved gases that may contaminate the high-purity water along with the monitoring and control of protective oxide film-preserving chemical additives. Power plant water chemistry monitoring instruments to do this are reaching a high state of development, but much still needs to be done to improve their measurement precision and reliability. Currently and commonly applied monitoring instruments include dissolved oxygen, hydrazine, dissolved hydrogen, pH, specific and cation conductivity, selective-ion electrodes (usually sodium), automatic flame photometers, turbidimeters, ion chromatographs, continuous membrane tape analyzers, continuous evaporators, and colorimetric analyzers (principally for silica). There have been many attempts at effective, continuous monitoring of corrosion product transport. The instruments used have included membrane filter tape analyzers and parts-per-billion turbidimeters. (See also W87-07279) (Lantz-PTT)
W87-07280

CRITICAL OVERVIEW OF POWER STATION SAMPLING AND ANALYSIS OF WATER AND STEAM,
Westinghouse Electric Corp., Philadelphia, PA.
O. Jonas.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 11-23, 3 fig, 2 tab, 8 ref.

Descriptors: *Powerplants, *Water quality control, *Water analysis, *Steam, Sampling, Corrosion, Organic compounds, Electrical equipment.

Because of the potential deleterious effects of impurities in water and steam, the current sampling and analytical practices are being critically evaluated, and methods and utilization of analytical data are being improved. To control the corrosion and efficiency loss, particularly in turbines, once-through boilers, reactors, and nuclear steam generators, low parts-per-billion levels of impurities are being sampled and analyzed. The critical areas reviewed in this presentation are sampling, grab sample, continuous, and in situ analysis; analysis of organics; and utilization of the data for system control and corrosion prediction. Certain improvements and refinements in all these areas are discussed. (See also W87-07279) (Author's abstract)
W87-07281

CONSULTING ENGINEER'S ROLE IN POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY,
Black and Veatch, Kansas City, MO.
T. C. Hoppe.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 24-29.

Descriptors: *Water quality control, *Measuring instruments, *Powerplants, *Industrial water, Hydraulic machinery, Turbines, Engineers.

The reassessment of high-purity water is a never-ending process. Although the best available instrumentation is used, it is not always good enough when component failures are attributed to infinitesimal impurities in the water. Design engineers are facing a dilemma in specifying power plant instrumentation for measurement of high-purity water, granting that part-per-billion or part-per-trillion levels of supposed contaminants can be measured. The design engineer has to provide such instrumentation as a concession to measuring the criteria imposed by the turbine supplier. The problem are: (1) how to approach water conditioning if it is conjectured that part-per-trillion levels of contamination in the cycle are responsible for stress-corrosion cracking of low-pressure turbine blades; (2) what the next step is to be in improving condensate polishing when the effluent sodium quality is only 0.1 ppb; and (3) is high-pressure steam to be polished to protect the turbine, and how can it be done economically. Variable pressure operation may reduce some of the station's generating capability but at the same time minimize potential water-related outages. If supercritical operation produces more outages, then another dilemma arises concerning the comparative economics of operating subcritically. Much more needs to be learned about the cycle materials of construction in relation to the effect of parts-per-trillion contamination levels instead of depending on better instrumentation to measure those levels. (See also W87-07279) (Lantz-PTT)
W87-07282

POWER PLANT INSTRUMENTATION FOR MEASUREMENT OF HIGH-PURITY WATER QUALITY,
Ontario Hydro Research Lab., Toronto.
J. Brown.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 30-33.

Descriptors: *Powerplants, *Water quality control, *Measuring instruments, *Ontario, *Toronto, *Cooling water, Grab samplers, Sampling, Ion chromatography, Corrosion control.

Work undertaken by Ontario Hydro, Toronto, to determine levels of feedwater impurities, including corrosion products and condenser cooling water in leakage contaminants, is reviewed. Corrosion product measurement using a grab method gave some useful data but was found to be too labor-intensive. Continuous analysis of corrosion products, in conjunction with a valveless capillary sampler, is now being evaluated as a method. Ion chromatography appears to be a promising technique to determine anions in feedwater. Tests to adapt such an instrument for continuous analysis are planned. (See also W87-07279) (Author's abstract)
W87-07283

STATUS OF CONTINUOUS MONITORING IN CENTRAL STATIONS,
Calgon Corp., Pittsburgh, PA.
D. E. Noll.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 37-48, 2 fig, 1 tab, 11 ref.

Descriptors: *Monitoring, *Water quality control, *Powerplants, *Measuring instruments, Steam, Feedwater, Boiler water.

The high level of sophistication required for the continuous monitoring of water quality in central stations follows from the need to produce ultra-pure steam. Although there may not be agreement on the precise levels of contamination that are tolerable in steam, there is concensus that the levels are extremely low - so low, in fact, that it is questionable whether commercially available instrumentation has been adequate for the job. Once the steam requirements are established, the specifications for boiler water and feedwater follow in order. This paper outlines several monitoring schemes for the complete utility plant cycle which employ the best monitoring equipment currently available and discusses some of the reasons that improved instrumentation is required. Because of the susceptibility of turbine alloys to stress-corrosion cracking and corrosion fatigue, the monitoring of steam for very low levels of contaminants is mandatory. Drum-type boilers operating on essentially pure water must be monitored with equal care because contaminants may cause wide swings in pH which lead to boiler tube corrosion. As condenser leaks are the most common source of contamination, selection of a monitoring scheme that will detect even minute condenser leaks is essential. Nearly instantaneous recognition of contamination is required because failure can be swift and catastrophic. Monitoring must, therefore, be continuous. (See also W87-07279) (Lantz-PTT)
W87-07284

POWER PLANT WATER QUALITY INSTRUMENTATION: A GUIDELINE FOR OPERATION, CALIBRATION, AND MAINTENANCE,
Selby and Associates, Chicago, IL.
K. A. Selby.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 49-54, 1 tab.

Descriptors: *Water quality control, *Powerplants, *Measuring instruments, Maintenance, Calibrations, Chemical analysis.

Experience in operating power plants has shown that water quality instrumentation should be operated, maintained, and calibrated by personnel directly responsible for plant chemistry functions. In this way a clear line of responsibility exists for the information produced by such equipment. The personnel assigned to the water quality instrumentation should have an education level equivalent to 2 years of college chemistry and additional training that will acquaint them with overall power plant operations. All instrumentation must receive daily attention. Routine maintenance and calibration procedures must be performed according to a set schedule to maintain consistency of operation. (See also W87-07279) (Lantz-PTT)
W87-07285

PROGRAM FOR STEAM PURITY MONITORING: 1. INSTRUMENTATION AND SAMPLING,
Westinghouse Research and Development Center, Pittsburgh, PA.
D. F. Pensenstadler, S. H. Peterson, J. C. Bellows, and W. M. Hickam.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1988. p 55-70, 11 fig, 1 tab, 3 ref.

Descriptors: *Monitoring, *Water quality control, *Measuring instruments, *Sampling, *Steam, Grab samples, Dissolved oxygen, Chlorides, Ion chromatography, Conductivity.

For the past 3 years the Westinghouse Electric Corp. has conducted a major program of instrument selection and development and sample analysis to monitor the steam turbine chemical environment and to determine the source of corrodant species that contribute to turbine blade corrosion. This paper describes the development and application of a continuous on-line analyzer: a grab sample analysis program, utilizing state-of-the-art ion chromatography, to measure steam impurity concentration at various locations throughout the steam-water cycle; and the combination of these techniques, in the form of a total plant survey, to assess total power plant chemistry. The significance and usefulness of continuously monitoring parameters such as sodium, dissolved oxygen, conductivities, and chloride is discussed, as are the validity of the sampling procedures, the utility of a nozzle to extract steam, and the strengths and weaknesses of ion chromatographic grab sample analyses. Finally, the implementation of a data acquisition system on the continuous analyzer, to handle the ever-increasing amount of information being generated by seven of these field systems is reviewed. (See also W87-07279; See also W87-07287) (Author's abstract)
W87-07286

PROGRAM FOR STEAM PURITY MONITORING: 2. RESULTS OF POWER PLANT TESTING,
Westinghouse Research and Development Center, Pittsburgh, PA.
S. H. Peterson, D. F. Pensenstadler, J. C. Bellows, and W. M. Hickam.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 71-79, 6 fig, 3 ref.

Descriptors: *Water quality control, *Monitoring, *Powerplants, *Steam, Ion chromatography, Sampling, Water quality, Boiler water, Corrosion.

The steam purity monitoring program of the Westinghouse Electric Corp. has accumulated a large data base on the chemical purity of water steam in modern fossil fuel power plants. Three types of monitoring have been employed: (a) grab samples taken during a plant visit and returned to the Westinghouse Research and Development Center for analysis by ion chromatography; (b) continuous analysis of steam condensate, extracted from the low-pressure (LP) turbine cross-over pipe, using the Westinghouse prototype steam purity monitor; and (c) total plant surveys of steam and water purity combining continuous analysis of LP steam and grab sampling of multiple locations to permit correlation of impurity levels throughout the plant during all essential operating cycles, including base load, load swings, and a shutdown and hot restart. The plants studied were selected to provide a variety of designs, including both drum and once-through boilers, various operating pressures, and different types of water treatment. Furthermore, care has been taken to study units that have experienced turbine corrosion and units that have operated for long periods without corrosion problems. Results are presented of this broad program of steam purity monitoring, with attention to the typical chemical environment of turbines in power plants in the United States. (See also W87-07279; See also W87-07286) (Author's abstract)
W87-07287

QUANTIFICATION OF SODIUM, CHLORIDE, AND SULFATE TRANSPORT IN POWER-GENERATING SYSTEMS,
NWT Corp., San Jose, CA.
T. B. Willhite, S. G. Sawochka, and W. L. Pearl.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 83-91, 4 fig, 4 tab, 4 ref.

Descriptors: *Measuring instruments, *Monitoring, *Nuclear powereplants, *Sodium, *Chlorides, *Sulfates, *Powerplants, Filtration, Ion exchange, Chromatography, Electrodes, Sampling.

In the performance of several chemistry monitoring programs for pressurized water reactors, integrating sampling devices are employed to concentrate low-level impurities present in the power-generation cycle. The devices employ a conventional Millipore membrane for collection of filterable species and separate cation and anion ion-

exchange columns for ionic species. The preparation for the ion-exchange columns involves resin pretreatment aimed at complete regeneration of resins, and in situ regeneration to ensure resin cleanliness and uniformity following column assembly. To complement and expand on results from the integrating ion-exchange columns, ion chromatography and specific ion electrode techniques were employed during short-term studies. These alternative techniques allow transient conditions to be monitored, whereas the integrated sampling system is deficient in this respect. Sodium, chloride, and sulfate concentrations determined with the different techniques were compared, and agreement was considered adequate for achieving program goals. (See also W87-07279) (Author's abstract)
W87-07288

DETERMINATION OF ANIONS IN HIGH-PURITY WATER BY ION CHROMATOGRAPHY,
Calgon Corp., Pittsburgh, PA.
J. A. Rawa.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 92-104, 4 fig, 5 tab, 6 ref.

Descriptors: *Water quality control, *Water analysis, *Chromatography, *Anions, *Measuring instruments, *Industrial water, Sodium, Potassium, Calcium, Magnesium, Effluents, Condensates, Chemical analysis, Pollutant.

Characterization of high-purity waters is a classic analytical problem because of a lack of sample integrity as well as inaccuracies in the analytical methods employed for measurement. For industrial process water applications, the purity of water with low dissolved solids content has been traditionally determined by on-line monitoring of specific conductance and sodium. Trace concentrations of cations (sodium, potassium, calcium, and magnesium) present in demineralizer effluents, condensates, and high-pressure boiler and boiler feedwaters have been determined by flame or flameless atomic absorption. Previously, there was no accurate method for measuring trace concentrations of anionic constituents. The introduction of a new analytical technique, ion chromatography (IC), has facilitated the identification and quantification of several anions - chloride, nitrate, orthophosphate, and sulfate at the micrograms-per-liter level. The IC technique incorporates the concepts of ion exchange and conductimetric detection. Without sample pretreatment, these anions can be accurately detected down to about 50 micrograms/L with a 100-micrcL sample injection. By concentrating the anions in the sample on a special low-capacity anion concentrator column, prior to IC analysis, these same anions can be readily detected at < 10 micrograms/L. The anion concentrator column technique has been applied successfully to the analysis of high-purity waters from various industrial process water systems. The advantages and limitations of the IC method are discussed. (See also W87-07279) (Author's abstract)
W87-07289

RECENT ADVANCES IN ION CHROMATOGRAPHY,
American Univ., Washington, DC. Dept. of Chemistry.
J. E. Girard, and J. A. Glatz.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 105-115, 6 fig, 4 tab, 15 ref.

Descriptors: *Measuring instruments, *Ion chromatography, *Water quality control, Pollutant identification, Chemical analysis, Chlorides, Nitrites, Sulfates, Anions.

The chromatographic separation and quantitation of highly ionic species was a difficult problem until recently. Ion chromatography (IC) represents a solution to this analytical problem. Nonsuppressed IC offers a new alternative method to practitioners of IC. Since a suppressor column is not necessary for this method, the time required to regenerate the suppressor column is saved. Better chromatographic efficiency is achieved with the suppressor removed. Peak reversal, a problem associated with the suppressor column, is also eliminated. The sensitivity for Cl(-) (0.5 ppm) is comparable to that of conventional suppressed IC. The sensitivities for NO3(-) (1.25 ppm) and SO4(2-) (1.25 ppm) are only slightly less than those observed for the conventional technique. (See also W87-07279) (Author's abstract)
W87-07290

IN-PLANT SYSTEM FOR CONTINUOUS LOW-LEVEL ION MEASUREMENT IN STEAM-PRODUCING WATER,
General Electric Co., San Jose, CA. Advanced Reactor Systems Dept.
J. L. Simpson, M. N. Robles, and T. O. Passell.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 116-130, 11 fig, 1 tab, 7 ref. EPRI Grant RP 1447.

Descriptors: *Measuring instruments, *Steam, *Ions, *Water quality control, *Powerplants, Monitoring, Chemical analysis, Water quality.

Described here is the development of an on-line analytical instrument to measure selected anions and cations over the sub-parts-per-billion to several parts-per-million concentration range. The system has been designed and is being installed in an electrical generating power plant. Laboratory evaluations and limited in-plant experiences and discussed regarding measurements of nonhydrolyzable anions and cations, transition metal ions, and organic acids. The system can accommodate multiple sample line inputs with computer-controlled options to provide sample averaging, automated sample point selection, and system standardization and calibration. The data acquisition capabilities, including storage and report generation, are also addressed. (See also W87-07279) (Author's abstract)
W87-07291

HIGH-PURITY WATER QUALITY MONITORING BASED ON ION-SELECTIVE ELECTRODE TECHNOLOGY,
Claremont Men's Coll., CA.
A. A. Diggens, S. Lichtenstein, J. C. Synnott, and S. J. West.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 131-138, 4 fig, 6 ref.

Descriptors: *Water quality control, *Monitoring, *Electrodes, *Ions, *Measuring instruments, *Powerplants, Sodium, Chlorides, Chlorine, Calcium, Sulfides, Chemical analysis, Water quality.

Power industry requirements for pure water demand instrumentation capable of detecting contaminants at very low levels. Moreover, precision and accuracy of measurement should be improved to allow reliable control. Although ion-selective electrodes have been employed successfully in the laboratory, certain problems have inhibited their utility in on-line monitoring applications. Recent work, briefly reviewed here, discusses these problems as encountered in the development of a sodium monitor. This effort has resulted in a second generation of ion-selective electrode-based devices which are less complex and, therefore, more reliable. Among these are monitors that measure chloride, chlorine, calcium, and sulfide in the parts-per-billion range. Hardware and chemistries are described, and data resulting from in-house and field evaluations are discussed. Work in progress for other parameters is presented. (See also W87-07279) (Author's abstract)
W87-07292

EVALUATION OF POWER PLANT MEASUREMENT OF SODIUM IONS IN HIGH-PURITY MAIN STEAM AND FEEDWATER UTILIZING IN-LINE CONTINUOUS SPECIFIC-ION ELECTRODES,
Baltimore Gas and Electric Co., MD.
R. F. Eherts.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 139-155, 13 fig, 7 ref.

Descriptors: *Powerplants, *Water quality control, *Monitoring, *Sodium, *Steam, *Calvert Cliffs Nuclear Power Plant, *Maryland, *Measuring, *Measuring instruments, Spectroscopy, Chromatography.

Discussed is the measurement of trace-level sodium concentrations in aqueous solutions. A comparison between the specific-ion electrode analyzer and other analytical methodologies is presented. The techniques include atomic absorption spectroscopy, flame emission spectroscopy, and ion chromatography. The data were obtained over approximately a 300-day period utilizing combinations of the aforementioned analytical techniques. The evaluation was performed at Calvert Cliffs Nuclear Power Plant (CCNPP), Lusby, Md., a pressurized water reactor owned and operated by Baltimore Gas and Electric Co. (BG and E). The data revealed that significant perturbations in the indicated sodium concentrations on the specific-ion electrode analyzers existed during the study period. Based upon the comparison data obtained by other analytical methodologies, the indicated sodium level variances were not considered to be representative of the actual system concentration variances. The perturbations in the indicated sodium levels were correlated with flow-pressure fluctuations in the specific-ion electrode sample lines. In addition, the accuracy of the instrument was diminished as the actual system sodium concentration varied outside the calibration limits of the analyzer. (See also W87-07279) (Author's abstract)
W87-07293

USE OF ON-LINE ATOMIC ABSORPTION IN A POWER PLANT ENVIRONMENT,
Westinghouse Research and Development Center, Pittsburgh, PA.
M. C. Skriba, G. B. Gockley, and J. A. Battaglia.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 156-166, 6 fig.

Descriptors: *Powerplants, *Water quality control, *Atomic absorption spectrophotometry, *Measuring instruments, Cooling water, Calcium, Magnesium, Aluminum, Spectrophotometry.

Westinghouse has been conducting a program to upgrade the purity of primary-loop cooling water in pressurized water reactor (PWR) nuclear power plants, and a method was needed to measure cationic impurities such as calcium, magnesium, and aluminum in the 0 to 10-ppb range. After examination of alternative methods,a Perkin-Elmer Model 5000 flameless atomic absorption (AA) unit with an AS-40 autosampler was selected and tested on line in a nonlaboratory, auxiliary building area of an operating nuclear power plant. Electrical isolation, dust and dirt protection, supplemental system cooling, and sample preconditioning all had to be provided to enable what is essentially a laboratory instrument to function in the more hostile plant environment. Some problems arose in the electronics of the spectrophotometer portion of the instrument, such as loss of preprogram instruction, multiple false readings, and loss of averaging functions. These problems were not of major proportions, however, and the system was able to track contamination levels through plant shutdown for refu-

eling and consistently monitor impurities in the sub-parts-per-billion range. It has been shown that with the new automated flameless AA systems, high-quality analyses can be obtained on line and without the need of a highly trained spectroscopist as an operator. (See also W87-07279) (Author's abstract)
W87-07294

RESISTIVITY OF VERY PURE WATER AND ITS MAXIMUM VALUE,
Foxboro Analytical, Burlington, MA.
For primary bibliographic entry see Field 1A.
W87-07296

CONTINUOUS CONDUCTIVITY MONITORING OF ANIONS IN HIGH-PURITY WATER,
Illinois State Water Survey Div., Champaign.
R. W. Lane, F. W. Sollo, and C. H. Neff.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 185-195, 8 fig, 2 tab, 7 ref.

Descriptors: *Conductivity, *Monitoring, *Water quality control, *Anions, *Measuring instruments, *Powerplants, Feedwater, Turbines, Chloride, Sulfates, Hydrogen ion concentration, Ammonia, Carbon dioxide.

The continuous and accurate monitoring of electrical conductivity of anions in feedwater and turbine condensate maybe performed by two new instruments, a Feedwater Analyzer and a Condensate Reboiler. The advantages of this testing technique are that carbon dioxide and ammonia interferences are eliminated, the conductivity is measured at constant temperature, and increased sensitivity to anions is attained by measuring the conductivity of anions in the acidic and more conducive form. Design changes in this equipment have made possible more accurate conductivity measurement in the range of 0.01 to 0.1 S/cm at atmospheric boiling water temperature. This results in increased sensitivity of measurement, so that 1 to 5 ppb of Cl(-) + SO4(2-) can be determined. An advantage is shown in that low levels of 0.01 to 0.5 mg/L of carbon dioxide (CO2) have a lower conductivity at atmospheric boiling temperature than at room temperature (25 C). More accurate cation conductivity results may therefore be expected by measurement at atmospheric boiling water temperature than by degassing with nitrogen. By including pH measurements along with conductivity and temperature measurements at room temperature, it is shown that ammonia and carbon dioxide of this two-component system may be calculated. Calculated ammonia and carbon dioxide results are shown not to be appreciably affected by the presence of 10 ppb chloride or more. The presence of 100 ppb total organic carbon (TOC) (as acetic acid) in steam condensate is also shown to have a negligible effect on the calculated ammonia and carbon dioxide results above 3 to 4 microS/cm. (See also W87-07279) (Author's abstract)
W87-07297

DESCRIPTION AND EVALUATION OF A CONTINUOUS SAMPLE WATER EVAPORATOR,
Babcock and Wilcox Co., Alliance, OH. Alliance Research Center.
S. J. Elmiger, N. J. Mravich, and C. C. Stauffer.
IN: Power Plant Instrumentation for Measurement of High-Purity Water Quality, A Symposium Sponsored by ASTM Committee D-19 on Water, ASTM, Milwaukee, Wisconsin, June 9-10, 1980. ASTM Special Technical Publication No. 742, 1981. p 196-212, 2 fig, 7 tab, 3 ref.

Descriptors: *Evaporators, *Measuring instruments, *Water sampling, *Water quality control, *Pollutant identification, Performance evaluation, Field tests, Calcium, Magnesium, Iron, Copper, Potassium, Chemical analysis.

Current power industry requirements place increasing emphasis on water and steam purity. Many of the contaminants present in plant systems exist at levels below the detection limits of available analytical methods. Evaporation of large volumes of water in a controlled environment provides a means of increasing the concentration of contaminants to a level that can be readily analyzed by current methodology. A new evaporator is capable of evaporating solutions from sample bottles or a sample line at rates approaching 500 cu cm/hr. The samples are concentrated in precleaned platinum dishes. A detailed description of the new evaporators and their operation is discussed. Performance tests were conducted on both laboratory and field samples to define the limitations of the evaporation process for trace chemical analysis. These analyses included calcium, magnesium, iron, copper, potassium, sodium, chromium, nickel, manganese, zinc, lead, aluminum, silica, sulfate, chloride, phosphate, and nitrate. The laboratory studies showed that the evaporators were capable of chemical species recovery generally within + and - 20% of the absolute amount of synthetic species added. Evaporation and analyses of field samples obtained from operating power plants compared favorably with other concentrating techniques for most species. However, there are certain contaminants which cannot be determined accurately with current evaporation techniques and may require analysis by other available methods. (See W87-07279) (Author's abstract)
W87-07298

EVALUATION OF METHODS FOR SAMPLING VEGETATION AND DELINEATING WETLANDS TRANSITION ZONES IN COASTAL WEST-CENTRAL FLORIDA, JANUARY 1979-MAY 1981,
Environmental Science and Engineering, Inc., Gainesville, FL.
R. Hart.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as AD-A144 677, Price codes: A06 in paper copy, A01 in microfiche. Army Engineer Technical Report Y-84-2, April 1984. Final Report. 121 p, 21 fig, 9 tab, 38 ref, 5 append. Contract No. DACW39-78-C-0099.

Descriptors: *Data collections, *Limnology, *Vegetation, *Wetlands, *Florida, *Aquatic plants, *Sampling, Plants, Trees.

Eight wetland types in west-central Florida were studied to formulate a method for determining the upper limits of wetlands, defining the boundaries of transition zones, and distinguishing both from the adjacent wetlands. The study was conducted in two phases. Phase I was an evaluation of vegetation sampling methods to determine procedures that most efficiently achieved an accurate representation of changes in abundance and composition of the more common plant species. The best method proved to be sampling of shrubs in 1 x 4 m quadrats and herbs in 1 x 1 m quadrats along contiguous 1 m segments of transects placed parallel to the moisture gradient. Trees were not adequately sampled by the method because the large areas required for adequate sampling often extended past the transition zone into adjacent upland or wetland areas. Frequency and percent cover were found to be the most rapidly employed and useful vegetational parameters for determining wetland boundaries. Phase II of the study consisted of evaluating two analytical methods for delineating transition zone boundaries. The first method consisted of calculating percent similarity between consecutive quadrats along the transects. The second method involved calculating weighted averages for all species based on the average distance of each species from the wetland endpoint of the transects. Calculation of percent similarity values entailed fewer calculations and provided less ambiguous boundary delineations. (Author's abstract)
W87-07300

MULTISPECTRAL REMOTE SENSING OF INLAND WETLANDS IN SOUTH CAROLINA: SELECTING THE APPROPRIATE SENSOR,
South Carolina Univ., Columbia. Dept. of Geography.
J. R. Jensen, M. Hodgson, E. J. Christensen, H. E. Mackey, and R. R. Sharitz.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE84-013951. Price codes: A02-PC in papercopy, A01-MF in microfiche. DuPont Report No. DP-MS--84-30, (1984). 21 p, 9 fig, 2 tab, 8 ref. DOE Contract DE-AC09-76SR00001.

Descriptors: *Wetlands, *Savannah River, *Watersheds, *Remote sensing, *South Carolina, Mapping, LANDSAT, Hydrologic maps.

To compare site wetlands information to regional wetlands inventories in the Savannah River watershed, a sensor was needed which could provide reasonable spatial resolution (e.g., a one acre minimum mapping unit), yet adequately discriminate wetland from all other land cover classes. Three LANDSAT MSS images obtained in the spring of 1977 provided the necessary information. The data sets were resampled to 80 m x 80 m pixels, digitally mosaicked, and rectified to a Universal Transverse Mercator (UTM) projection. The boundaries of the nine USGS hydrologic units encompassing the Savannah River watershed were also registered to the UTM projection. In effect, a GIS system was created which covered more than 27,000 sq km in Georgia, South Carolina, and North Carolina. The Savannah River watershed map was produced using a supervised classification procedure. The acreage of each land cover type was extracted and evaluated by USGS hydrolgic unit. Although LANDSAT MSS data cannot provide the detailed type of wetland information necessary for the delta studies, it can be used for regional assessments of wetland and other land cover in the southeastern United States if early spring imagery is analyzed. (Lantz-PTT)
W87-07307

ANNUAL EFFLUENT AND ENVIRONMENTAL MONITORING REPORT FOR CALENDAR YEAR 1983.
Bettis Atomic Power Lab., West Mifflin, PA.
Available from the National Technical Information Service, Springfield, Virginia 22161, as DE84015502. Price codes: A03-PC in papercopy, A01-MF in microfiche. Westinghouse Report No. WAPD--337, July 1984. 40 p, 1 fig, 5 tab, 15 ref, append. DOE Contract DE-AC11-76PN00014.

Descriptors: *Water quality control, *Water pollution effects, *Environmental effects, *Monitoring, *West Mifflin, *Pennsylvania, *Effluents, *Radioactivity, Regulations, Industrial water.

The results of the effluent and environmental monitoring program for 1983 at the Bettis Laboratory are presented. The results obtained from the effluent monitoring program demonstrate that the existing procedures for controlling liquid and airborne effluents ensure that all such releases during 1983 were made in accordance with applicable Federal regulations. Evaluation of the effluent and environmental data indicates that the operation of the Laboratory continued to have no adverse effect on the quality of the environment. Furthermore, a conservative assessment of the radiation exposure for the small radioactivity releases from the Bettis Laboratory demonstrated that the dose estimates were too low to measure and were well below the most restrictive dose limits prescribed by the Environmental Protection Agency and the Department of Energy. (Author's abstract)
W87-07308

HYDROLOGICAL FORECASTING.
For primary bibliographic entry see Field 2A.
W87-07346

USE OF RADAR FOR PRECIPITATION MEASUREMENTS,
Texas A and M Univ., College Station. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W87-07350

REMOTE SENSING OF SOIL MOISTURE,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W87-07351

DISPERSION OF PARTICLES AFTER DISPOSAL OF INDUSTRIAL AND SEWAGE WASTES,
Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 5B.
W87-07402

TESTING AND EVALUATION OF STABILIZED COAL WASTES FOR OCEAN DISPOSAL,
State Univ. of New York at Stony Brook. Coll. of Engineering and Applied Sciences.
H. R. Carleton, and F. F. Y. Wang.
IN: Wastes in the Ocean, Volume 1: Industrial and Sewage Wastes in the Ocean. John Wiley and Sons, New York, New York. 1983. p 355-374, 5 fig, 3 tab, 17 ref.

Descriptors: *Coal mining, *Measuring instruments, *Mine wastes, *Ocean dumping, *Waste disposal, *Compressive strength, *Elastic modules, Sludge stabilization, Coal, Sludge, Fly ash, Wastewater treatment.

A variety of compositions of fly ash and filtercake scrubber sludge stabilized with lime were evaluated in the laboratory and at an offshore site over a period of two years. The primary purpose of this work was to establish the suitability of stabilized coal wastes over an extended period, and to determine those properties that adequately reflect physical integrity. Groups of test blocks were prepared from fly ash and scrubber sludge obtained from two eastern coal-burning power plants. Blocks were divided into groups for placement at an Atlantic Ocean test site (at 25 m depth) and for laboratory tests in seawater tanks. The apparent elastic modulus of these materials was evaluated using a time-of-flight ultrasonic intervalometer operating at 162 kHz developed for this application. All blocks were ultimately tested for compressive strength in the laboratory to obtain correlation between compression strength and elastic modulus. Results showed that the ultrasonic method was a sensitive indicator of internal physical changes. The accuracy of the method was sufficient to differentiate block-to-block variations in density and to reflect changes in water absorption and cementation. (See W87-07396) (Author's abstract)
W87-07414

ASTM POWER PLANT WATER ANALYSIS MANUAL.
American Society for Testing and Materials, Philadelphia, PA. Committee D-19 on Water.
For primary bibliographic entry see Field 5A.
W87-07419

IDENTIFICATION OF EXISTING WATER QUALITY DATA.
JRB Associates, Inc., Bellevue, WA.
Available from the National Technical Information Service, Springfield, Virginia 22161, as PB84-242635. Price codes: A04 in paper copy, A01 in microfiche. Final Report, March 30, 1984. EPA Report No. 910/9-83-118b. 67 p, 11 fig, 6 tab. EPA Contract 68-6348.

Descriptors: *Water quality, *Puget Sound, *Washington, *Data collections, Water quality control, Environmental control, Biological analysis, Chemical analysis, Monitoring.

With the demonstration of adverse environmental change in Puget Sound in recent years, there is increasing concern over the environmental quality of the Sound's waters. In order to protect against further deterioration, there is a clear need to establish a sensitive monitoring program which will adequately document either improvement or degradation of environmental quality. The objective of this task is to identify existing water quality and related data for Puget Sound, the Strait of Juan de Fuca and the Strait of Georgia, and to present this information in a manner that will facilitate easy access and be valuable in design of future work in Puget Sound. The water quality data included encompasses a broad diversity of data types, including virtually any parameter that could potentially serve as an indicator of environmental quality. For example, biological data of interest ranges from fecal coliform counts to population studies of marine mammals. A similar wide diversity of chemical and hydrographic data is included. Major emphasis was placed on data representing repeated samples at specific sites, since this information would be most applicable to a long-term monitoring program. However, data gathered during a single survey was also included if available. The intent of this task was to identify water quality related data that is not widely known of, and is not readily available to environmental managers. (Lantz-PTT)
W87-07428

DETERMINATION OF GREEN-AMPT PARAMETERS USING A SPRINKLER INFILTROMETER,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
S.-T. Chu.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 501-504, March-April 1986. 2 fig, 4 tab, 8 ref.

Descriptors: *Green-Ampt parameters, *Infiltration, *Sprinkler infiltrometer, *Measuring instruments, *Time ratio, Soil profiles, Model studies, South Dakota, Field tests, Loam.

Green-Ampt infiltration parameters were used to describe the soil infiltration characteristics. Sprinkler infiltrometer data were applied to determine the Green-Ampt parameters. A quantity referred to as the time ratio is introduced. The time ratio plays a key role in the evaluation process. An iterative procedure using the time ratios to determine the Green-Ampt parameters from sprinkler infiltrometer data is presented. Three sets of sprinkler infiltrometer data collected from the Plant Science Research Farm, South Dakota State University, Brookings, SD were presented to illustrate the application of the iterative procedure in practice. The Green-Ampt infiltration parameters for Vienna loam were determined as $K = 2.11$ cm/h and $SM = 0.74$. For tilled Vienna loam, the parameters are $K = 7.72$ cm/h and $SM = 0.13$ cm. These parametric values can be used as input information for a crusted Green-Ampt infiltration model to describe the infiltration process on a crusted layered soil profile. (Alexander-PTT)
W87-07458

LOW- AND MIDLEVEL CLOUD ANALYSIS USING NIGHTTIME MULTISPECTRAL IMAGERY,
Air Force Geophysics Lab., Hanscom AFB, MA.
R. P. d'Entremont.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1853-1869, December 1986. 9 fig, 4 tab, 10 ref.

Descriptors: *Multispectral cloud analysis, *Remote sensing, *Radiometry, *Measuring instruments, *Clouds, Spectral analysis, Infrared imagery.

A multispectral cloud analysis technique using NOAA-7 Advanced Very High Resolution Radiometer (AVHRR) infrared imagery was developed and tested using the AFGL Man-computer Interactive Data Access System (McIDAS) and the AFGL Interactive Meteorological System (AIMS). Fractional cloud amount and cloud top heights are computed for low-level clouds at night, including subpixel resolution clouds (i.e., clouds which only partially fill a sensor's field of view). Multispectral analysis offers a technique for detecting low cloud, which is better than cloud analysis using single channel infrared imagery. Theoretical radiances are computed at the 3.7, 10.7 and 11.8 micron infrared spectral bands of the AVHRR as a function of cloud top altitude and cloud amount for a range of cloud conditions. Satellite-measured radiances are then compared to the theoretical values at each wavelength to determine the best cloud height/cloud amount match for a pixel. Test case comparisons using manually selected clear and partially cloud-filled regions of AVHRR imagery as displayed on AIMS showed good agreement between the multispectral analysis results and evaluation by human interpretation of the images, surface cloud observations and upper air soundings. (Author's abstract)
W87-07505

EXTRACTION OF PERIPHYTON ADENOSINE TRIPHOSPHATE AND VARIABILITY IN PERIPHYTON-BIOMASS ESTIMATION,
Geological Survey, Salt Lake City, UT.
D. W. Stephens.
Archive fuer Hydrobiologie AHYBA4, Vol. 108, No. 3, p 325-335, January 1987. 4 fig, 2 tab, 19 ref.

Descriptors: *Analytical methods, *Data acquisition, *Adenosine triphosphate, *Periphyton, *Biomass, Techniques, Field tests, On-site tests, Variability.

A technique for the field extraction of periphyton adenosine triphosphate (ATP) was developed that allows rapid processing of replicate sections of artificial substrates. The method utilizes 6-millimeter-diameter discs that are punched from a colonized plastic strip from which the periphyton are extracted using a sulfuric-oxalic acid solution with silica sand as an abrasive. Extraction is accomplished in small-volume plastic vials that allow multiple samples to be processed easily. The method was quantitative and allowed extracted and acidified field samples to be refrigerated for as long as 20 hours or frozen for months without the loss of ATP. This method represents an improvement in analytical methods used to measure components of periphyton biomass because: (1) sampling of sections of the periphyton strip can be randomized; (2) a large number of samples can be processed quickly and stored easily; and (3) sufficient samples can be processed to keep the variability within reasonable limits. Variability of ATP extraction and analysis of three replicate samples per strip is about plus or minus 13 percent; an improvement over other methods. Laboratory and field experiments indicate that concentrations of periphyton ATP have the greatest variability in the initial 100 hours of colonization. Variability decreases for about 300 hours and is less predictable after that time. (Wood-PTT)
W87-07524

FLUORIMETRIC DIFFERENTIAL-KINETIC DETERMINATION OF SILICATE AND PHOSPHATE IN WATERS BY FLOW-INJECTION ANALYSIS,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
P. Linares, M. D. Luque de Castro, and M. Valcarcel.
Talanta TLNTA2, Vol. 33, No. 11, p 889-893, November 1986. 2 fig, 5 tab, 27 ref. CAICyT Grant 2012-83.

Descriptors: *Analytical methods, *Flow-injection analysis, *Water analysis, *Chemical analysis, *Pollutant identification, *Silicates, *Phosphates, Anions, Detection limits, Chemical reactions, Optimization.

A flow-injection analysis (FIA) method for simultaneous determination of silicate and phosphate is suggested based on the different rates of formation of their molybdate heteropoly acids. The fluorimetrically monitored product is thiochrome, formed by oxidation of thiamine by the heteropoly acid. The FIA configurations designed allow performance of two measurements at different times on each sample injected. The method permits the determination of these anions in the range 30-600 ng/ml in ratios from 1:10 to 10:1 and can be applied to samples of running and bottled water with good results. The sampling frequency achievable is 60/hr. The precision of the proposed method is similar to that of other differential-kinetic procedures, but the method has certain advantages over earlier methods: (1) the fluorimetric detection gives a lower determination limit than that of the other methods; (2) determination of both species in a

single injection; (3) freedom from interferences, which allows its application to real samples. (Author's abstract)
W87-07569

WATER UTILITY PROGRAMS FOR THE FUTURE: A WEST TEXAS CITY SOLVES ITS UTILITY PROBLEMS WITH INNOVATIVE USE OF MICROPROCESSOR BASED RADIO TELEMETRY,
For primary bibliographic entry see Field 5F.
W87-07583

PRECIPITATION PRODUCTION IN THREE ALBERTA THUNDERSTORMS,
McGill Univ., Montreal (Quebec). Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W87-07591

7C. Evaluation, Processing and Publication

SPACE-TIME MODELING OF VECTOR HYDROLOGIC SEQUENCES,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
For primary bibliographic entry see Field 2E.
W87-06689

MODELING TOC REMOVAL BY GAC: THE GENERAL LOGISTIC FUNCTION,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W87-06766

ECOLOGICAL ASSESSMENT OF MACROPHYTON: COLLECTION, USE, AND MEANING OF DATA.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 2H.
W87-06899

QUANTITATIVE METHODS FOR ASSESSING MACROPHYTE VEGETATION,
Wisconsin Geological and Natural History Survey, Madison.
For primary bibliographic entry see Field 2H.
W87-06901

BIOSTATISTICAL ASPECTS OF MACROPHYTON SAMPLING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 2H.
W87-06903

FIRST-ORDER ERROR ANALYSIS FOR AQUATIC PLANT PRODUCTION ESTIMATES,
Notre Dame Univ., IN. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-06904

MAPPING-SURFACE OR GROUND SURVEYS,
Environmental Protection Agency, Athens, GA. Environmental Services Div.
For primary bibliographic entry see Field 2H.
W87-06909

FRAMEWORK FOR THE COMPLEMENTARY USE OF MATHEMATICAL MODELS AND MICROCOSMS IN ENVIRONMENT ASSESSMENT,
Tetra Tech, Inc., Lafayette, CA.
D. B. Porcella, C. W. Chen, R. K. Kawaratani, J. Harte, and D. Levy.
IN: Validation and Predictability of Laboratory Methods for Assessing the Fate and Effects of Contaminants in Aquatic Ecosystems. A Symposium Sponsored by The Amer. Inst. of Biology, The Ecological Soc. of America, and ASTM Committee E047, Grand Forks, ND, Aug. 8, 1983. 1985. p 204-211, 3 fig, 1 tab, 7 ref. Electric Power Research Inst. RP2046-2.

Descriptors: *Data interpretation, *Mathematical models, *Microcosms, *Environmental assessment, *Model studies, Ecosystems, Simulation analysis, Ammonium, Aquatic environment.

A framework was developed for the complementary use of mathematical models and microcosms in environmental assessment. A part of the framework was the use of microcosm data to define important ecological processes, including the mathematical functions and their rate coefficients, for inclusion in the mathematical model. As a case study, a mathematical model developed previously for the ecological assessment of power plant impacts was adapted to simulate the experimental conditions of a microcosm. Results indicated that ammonium absorption from the air was an important process for the microcosms but was not included in the simulation model. In most environmental situations, this is not an important process for simulation. The rate coefficients, compiled from the literature and used in the model to date, were generally applicable to the microcosms. Use of the mathematical model to anticipate results of microcosm experiments can help optimize the sample collection and analysis program necessary to meet the experimental design. (See also W87-06912) (Author's abstract)
W87-06926

COMPUTERIZATION IN THE WATER AND WASTEWATER FIELDS.
For primary bibliographic entry see Field 5D.
W87-06965

INTRODUCTION TO COMPUTERS,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
B. Carnahan.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 1-17, 1 fig.

Descriptors: *Computers, *Computer programs, Automation, Hardware, Software, Digital computers, Analog computers, Water treatment, Municipal water, Water treatment facilities.

Many people have computing experience and some may be very knowledgeable about computers. However, this chapter assumes that the reader knows nothing about them and starts from scratch. The following topics are discussed: (1) machine organization - how computers are organized from a functional standpoint; (2) operating systems - special programs that allow effective computer use; (3) programming languages - permits the writing of orders for the computer; (4) system programs - programs that are generally useful for managing the computing system and, in some cases, managing an office; (5) application programs - programs that solve problems of interest to the users; and (6) networks and communication - linking computers together, communication between computers. (See also W87-06965) (Lantz-PTT)
W87-06966

SELECTING A COMPUTER AND SOFTWARE: A USER'S VIEWPOINT,
Wyoming Wastewater Treatment Plant, Grandville, MI.
D. P. Wolz.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 19-26.

Descriptors: *Management planning, *Computers, *Computer programs, Performance evaluation, Economic aspects, Benefits.

Before a computer system can be configured at a facility, preparation is necessary. Basic questions which must be answered in some manner before hardware and software can be selected are: (1) what the current duties are, and whether these duties can be computerized; (2) what can the computer do to assist. A computer properly programmed can do just about anything, but if the application is exotic or unique, special software and people will be needed to maintain it; (3) what the costs involved will be. After deciding what to do, look realistically at what the market is offering and see if it meets the needs; and (4) what are the potential benefits. (See also W87-06965) (Lantz-PTT)
W87-06967

USE OF COMPUTERS IN WATER SUPPLY REGULATION,
Michigan Dept. of Public Health, Lansing. Div. of Water Supply.
J. K. Cleland, and K. Kalinowski.
IN: Computerization in the Water and Wastewater Fields, Lewis Publishers, Inc., Chelsea, Michigan. 1986. p 27-33, 1 fig.

Descriptors: *Computers, *Water supply, *Michigan, *Management planning, *Water management, Computer programs, Regulations.

There are many good reasons why the State of Michigan could benefit from the purchase of computer systems, some not obvious to the public or a person working in the water supply industry representing utilities, consulting services or vendors of products used in the industry. Why computer systems are valuable in water supply regulation, and why they employ a combination of mainframe and microcomputer systems to best meet data handling needs, is explained. The application of computers in state regulation falls into three broad categories: those applications resulting directly from statutory requirements: those which directly assist program activities and provide management information both in and outside the agency; and those which are projected but as yet are not in service. Statutory requirements, data and evaluation, certification, administration, and water production and use, are just some of the applications discussed. (See also W87-06965) (Lantz-PTT)
W87-06968

COMPUTER AIDED MAPPING AND DESIGN,
Engineerng and Graphic Services, Inc., Oak Park, MI.
For primary bibliographic entry see Field 7A.
W87-06975

USE OF A GEOGRAPHIC INFORMATION SYSTEM FOR STORM RUNOFF PREDICTION FROM SMALL URBAN WATERSHEDS,
Yale Univ., New Haven, CT. School of Forestry and Environmental Studies.
J. K. Berry, and J. K. Sailor.
Environmental Management EMNGDC, Vol. 11, No. 1, p 21-27, January 1987. 2 fig, 4 tab, 14 ref.

Descriptors: *Automation, *Model studies, *Storm runoff, *Urban watersheds, *Urban hydrology, *Map analysis, *Data interpretation, Flow, Sensitivity analysis, Prediction, Watersheds, Basins, Simulation, Runoff.

The use of computer-assisted map analysis techniques for prediction of storm runoff from a small urban watershed in the United States is investigated. An automated procedure for calculating input parameters for the US Soil Conservation Service (SCS) method of predicting storm runoff volume and peak timing is presented. Advanced techniques of spatial analysis are used to characterize spatial coincidence, surface configuration and effective hydrologic distance. A limited verification of the automated procedure indicates that the model reasonably characterizes water flow. A sensitivity analysis of basin disaggregation suggests that the SCS method yields increased volume and peak discharge predictions as the watershed is divided into smaller and smaller subunits. As a means to demonstrate the practical application of the automated procedure, a simulation of the effects on surface runoff for a potential residential development is presented. (Author's abstract)
W87-07082

ESTIMATING FRESHWATER INFLOW NEEDS FOR TEXAS ESTUARIES BY MATHEMATICAL PROGRAMMING,
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2L.
W87-07104

BEHAVIOR OF SENSITIVITIES IN THE ONE-DIMENSIONAL ADVECTION-DISPERSION EQUATION: IMPLICATIONS FOR PARAMETER ESTIMATION AND SAMPLING DESIGN,
Geological Survey, Reston, VA.
D. S. Knopman, and C. I. Voss.
Water Resources Research WRERAQ, Vol. 23, No. 2, p 253-272, February 1987. 18 fig, 7 tab, 47 ref.

Descriptors: *Path of pollutants, *Solute transport, *Porous media, *Mathematical equations, *Sensitivity, *Model studies, *Advection, *Dispersion, Mathematical models, Mathematical studies, Estimating equations, Sampling, Sampling design, Regression analysis, Velocity, Probability distribution.

The spatial and temporal variability of sensitivities has a significant impact on parameter estimation and sampling design for studies of solute transport in porous media. Physical insight into the behavior of sensitivities is offered through an analysis of analytically derived sensitivities for the one-dimensional form of the advection-dispersion equation. When parameters are estimated in regression models of one-dimensional transport, the spatial and temporal variability in sensitivities influences variance and covariance of parameter estimates. Several principles account for the observed influence of sensitivities on parameter uncertainty. (1) Information about a physical parameter may be most accurately gained at points in space and time with a high sensitivity to the parameter. (2) As the distance of observation points from the upstream boundary increases, maximum sensitivity to velocity during passage of the solute front increases and the consequent estimate of velocity tends to have lower variance. (3) The frequency of sampling must be 'in phase' with the S shape of the dispersion sensitivity curve to yield the most information on dispersion. (4) The sensitivity to the dispersion coefficient is usually at least an order of magnitude less than the sensitivity to velocity. (5) The assumed probability distribution of random error in observations of solute concentration determines the form of the sensitivities. (6) If variance in random error in observations is large, trends in sensitivities of observation points may be obscured by noise and thus have limited value in predicting variance in parameter estimates among designs. (7) Designs that minimize the variance of one parameter may not necessarily minimize the variance of other parameters. (8) The time and space interval over which an observation point is sensitive to a given parameter depends on the actual values of the parameters in the underlying physical system. (Author's abstract)
W87-07107

NUMERICAL ESTIMATION OF EFFECTIVE PERMEABILITY IN SAND-SHALE FORMATIONS,
Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 2F.
W87-07108

EFFECT OF REGIONAL HETEROGENEITY ON FLOOD FREQUENCY ESTIMATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07111

FIELD-SCALE EVALUATION OF INFILTRATION PARAMETERS FROM SOIL TEXTURE FOR HYDROLOGIC ANALYSIS,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2G.
W87-07112

RECURSIVE STATE AND PARAMETER ESTIMATION WITH APPLICATIONS IN WATER RESOURCES,
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 2A.
W87-07145

SPATIAL AND TEMPORAL ANALYSIS OF THE RECENT DROUGHT IN THE SUMMER RAINFALL REGION OF SOUTHERN AFRICA,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W87-07153

HYDROLOGICAL DATA MANAGER AND DIGITIZATION IN 1985: POINTS TO PONDER IN THE DEVELOPMENT OF A NEW DIGITIZING SYSTEM,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
M. C. Dent, and R. E. Schulze.
Water S. A. WASADV, Vol. 13, No. 1, p 49-52, January 1987. 2 fig, 16 ref.

Descriptors: *Data processing, *Digitization, *Computer programs, *Data storage and retrieval, *Rainfall, *Runoff, *Computers, Motivation, Errors, Personnel management, Data processing.

The information which is extracted from digitized autographic rainfall and runoff records is used in a large number of design decisions. In addition these data are invaluable to many hydrological research programs. The role of the person who performs the digitizing, the digitizor, is most vital to the success of this aspect of hydrological research. Consequently the system design should center around the motivational and operational requirements of this person. The recently designed system which is in operation in the Department of Agricultural Engineering at the University of Natal is described in order to illustrate these design requirements. The new digitizing system makes full use of the latest hardware and software technology and in so doing allows the digitizor considerable flexibility and control over the process of digitizing. (Author's abstract)
W87-07155

COMPUTERIZED DATA BASE FOR FLOOD PREDICTION MODELING,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-07177

SOME TECHNIQUES FOR USING FREQUENCY ANALYSIS AND REALTIME DATA TO INTERPRET FLOOD POTENTIAL DATA,
Boise National Forest, ID.
For primary bibliographic entry see Field 2E.
W87-07190

WATER QUALITY MONITORING RIVERS AND STREAMS: 1984.
Indiana State Board of Health, Indianapolis. Div. of Water Pollution Control.
Indiana State Board of Health, 1984. 141 p.

Descriptors: *Water quality, *Monitoring, *Indiana, *Water pollution sources, *Data collections, Path of pollutants, Physical analysis, Chemical analysis, Microbiological analysis.

This program was established to provide basic information which would reveal pollution trends and provide water quality data for the many existing and prospective users of surface water in Indiana. The importance of surface waters is emphasized by the fact that two-thirds of the water usage in Indiana in 1980 was obtained from surface supplies. The monitoring program has these specific objectives: (1) to determine chemical, physical, bacteriological, and biological characteristics of Indiana water under changing conditions; (2) to indicate, when possible, the sources of pollution entering a stream; (3) to compile data for future pollution abatement activities; (4) to determine background data on certain types of wastes, such as chlorides and radioactive materials, and to detect critical changes; (5) to obtain data useful for municipal, industrial, agricultural, and recreation uses; and (6) to procure data useful and necessary for securing public action toward the preservation of streams for all beneficial uses. This is the twenty-sixth annual water quality report on the major surface waters of Indiana. In April 1957, the Division of Sanitary Engineering, Indiana State Board of Health, established 49 sites for the bi-weekly collection of samples for physical, chemical, and bacteriological analyses, and 10 of the stations were sampled for radiological analyses. Various changes and improvements have been made since the program was established in 1957. At the present time, 93 stations are included in the total program. Physical, chemical, and bacteriological analyses are made on samples collected from all 93 of these stations, plankton analyses from 18, and radiological analyses from 24. (Lantz-PTT)
W87-07301

ANNUAL EFFLUENT AND ENVIRONMENTAL MONITORING REPORT FOR CALENDAR YEAR 1983.
Bettis Atomic Power Lab., West Mifflin, PA.
For primary bibliographic entry see Field 7B.
W87-07308

REGIONAL AQUIFER-SYSTEM ANALYSIS PROGRAM OF THE U.S. GEOLOGICAL SURVEY: SUMMARY OF PROJECTS, 1978-84.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-07312

IDENTIFICATION OF EXISTING WATER QUALITY DATA.
JRB Associates, Inc., Bellevue, WA.
For primary bibliographic entry see Field 7B.
W87-07428

APPLICATION OF PARAMETRIC MIXED-INTEGER LINEAR PROGRAMMING TO HYDROPOWER DEVELOPMENT,
Hydro-Quebec, Varennes.
A. Turgeon.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 399-407, March 1987. 8 fig, 3 tab, 2 ref.

Descriptors: *Data interpretation, *Reservoirs, *Hydroelectric power, *Capital, *Linear programming, Computers, Algorithms, Site selection.

The problem consists in selecting the sites on the river where reservoirs and hydroelectric power plants are to be built and then determining the type and size of the projected installations. The solution obviously depends on the amount of money the utility is willing to invest, which itself is a function of what the new installations will produce. It is therefore necessary to solve the problem for all possible amounts of firm energy produced, since it is not known at the outset which production level the utility will select. This is done in the paper by a parametric mixed-integer linear programming (MILP) method whose efficiency derives from the fact that the branch-and-bound algorithm for selecting the sites to be developed (and consuming most of the computer time) is solved a minimum number of times. Between the points where the MILP problem is solved, LP parametric analysis is applied. (Author's abstract)
W87-07471

INTERPOLATION OF BINARY SERIES BASED ON DISCRETE-TIME MARKOV CHAIN MODELS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou, and T. T. Georgiou.
Water Resources Research WRERAQ, Vol. 23, No. 3, p 515-518, March 1987. 2 tab, 10 ref,

append.

Descriptors: *Markov chain models, *Model studies, *Data interpretation, *Time series, *Interpolation, Probabilistic process, Distribution, Rainfall, Statistics.

The problem of interpolating missing observations in a time series modeled by a discrete-time Markov chain is considered. The general interpolation scheme involves a finite enumeration of all possible paths (i.e., admissible values for the missing data) and computation of the probability distribution of the paths. Procedures for the selection of a particular path are discussed in terms of a prespecified interpolation objective. In the special case of two-state Markov chains, an efficient way of enumerating the paths based on the set of sufficient statistics is investigated. An example using daily rainfall occurrence series is presented. (Author's abstract)
W87-07482

METHOD FOR COUPLING A PARAMETERIZATION OF THE PLANETARY BOUNDARY LAYER WITH A HYDROLOGIC MODEL,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
J. D. Lin, and S. F. Sun.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 12, p 1971-1976, December 1986. 3 fig, 16 ref. NASA Grants NSG 5075 and NSG 5346.

Descriptors: *Climatology, *Planetary boundary layers, *Hydrologic models, *Model studies, *Data interpretation, Simulation, Boundary layers, Atmosphere, Hydrology.

Deardorff's parameterization of the planetary boundary layer is adapted to drive a hydrologic model. The method converts the atmospheric conditions measured at the anamometer height at one site to the mean values in the planetary boundary layer; it then uses the planetary boundary layer parameterization and the hydrologic variables to calculate the fluxes of momentum, heat and moisture at the atmosphere-land interface for a different site. A simplified hydrologic model is used for a simulation study of soil moisture and ground temperature on three different land surface covers. The results indicate that this method can be used to drive a spatially distributed hydrologic model by using observed data available at a meteorological station located on or nearby the site. (Author's abstract)
W87-07512

PLUGGING INTO A DAM,
Illinois Univ. at Chicago Circle.
M. L. Silver, and J. H. Rogers.
Civil Engineering (ASCE) CEWRA9, Vol. 56, No. 5, p 56-58, May 1986. 3 fig.

Descriptors: *Data interpretation, *Dam stability, *Hydraulic engineering, *Computer programs, *Monitoring, *Safety, *MIDAS, *Automation, *Dams, *Dam failure, *Russell Dam, Hydraulic structures, Dam foundatation, Foundation failure, Georgia, Embankments, Estimating, Performance evaluation, Seepage.

A sophisticated computer program known as MIDAS (Management of Information for Dam Safety) is being used to maintain records and analyze the performance of the newly constructed Richard B. Russell Dam on the Savannah River, about 63 miles above Augusta, GA. The program rapidly and economically summarizes, plots, and evaluates data from instruments embedded in the dam's embankments. The instrumentation includes piezometers to monitor internal pore pressure, inclinometers to track lateral displacement, settlement gauges to measure vertical displacement, and other instruments. MIDAS makes it possible to store, update, retrieve, and analyze in real time large volumes of information from these instruments. Instrumentation at the dam is read on a fixed schedule designed to optimize the evaluation of dam performance. User-friendly interactive commands can be used to plot the relationship between performance data and environmental information. MIDAS can also develop statistical or numerical models of acceptable dam performance against which measured dam performance can be compared. The differences between observed and expected performance are then compared against preset tolerances; if these are exceeded, a warning shows on the computer screen and on hard copy plots. The U.S. Army Corps of Engineers is planning to use MIDAS to evaluate the performance of a number of its other dams. (Doria-PTT)
W87-07582

8. ENGINEERING WORKS

8A. Structures

STRENGTH DESIGN OF REINFORCED CONCRETE HYDRAULIC STRUCTURES, REPORT 4: LOAD-MOMENT CHARACTERISTICS OF REINFORCED CONCRETE CIRCULAR CONDUITS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8F.
W87-07018

ANNOTATED BIBLIOGRAPHY FOR NAVIGATION TRAINING STRUCTURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. E. Pankov, and R. F. Athow.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report REMR-HY-1, July 1986. Final Report. 63 p.

Descriptors: *Bibliographies, *Navigation structures, *Training, *Scour, *River training, Hydraulic structures, Maintenance.

The navigation projects of America were the focus of a study to develop new and improved technology for repair and rehabilitation of estuarine and riverine deep- and shallow-draft training structures. Establishment of the Corps of Engineers Repair, Evaluation, Maintenance, and Rehabilitation Research (REMR) program was the basis for the development of methods for detecting scour damage at these structures, setting up rationale for defining damaging scour, and identifying and evaluating techniques and equipment for repair of such damage. This report, a bibliography, is to serve as a reference base. It is divided into three categories: General Overview, Scour and Scour Damage, and Repair Techniques. (Author's abstract)
W87-07027

LITTLE SIOUX CONTROL STRUCTURE, LITTLE SIOUX RIVER, IOWA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. E. Hite.
Available from the National Technical Information Serivce, 5285 Port Royal Road, Springfield, VA 22161 as ADA171592. Price codes: A06-PC in papercopy, A01-MF in microfiche. Army Corps of Engineers Technical Report HL-86-5, June 1986. Final Report. 98 p, 4 tab, 27 photos, 37 plates.

Descriptors: *Little Sioux Control Structure, *Little Sioux River, *Iowa, *Hydraulic models, *Model studies, *Channels, Channel improvement, Channel flow, Flow profiles, Design criteria, Structural models, Weirs, Hydraulic structures, Riprap, Flow discharge.

The Little Sioux Project, located in Woodbury, Monona, and Harrison Counties, Iowa, consisted of remedial work on the channel of the Little Sioux River, three existing sills at the mouth of the river, and the construction of a channel control structure about 5.75 miles above the mouth. A model study of the original channel control structure was conducted to develop a satisfactory design for discharges up to 10,000 cfs. Since the construction of the original control structure, the channel has degraded 11 ft and flows exceeding 10,000 cfs have occurred regularly. Flows exceeding the berm height scoured the side slopes causing the riprap to fail, and convergence of the concentrated flows from the right and left bank berm sections caused the development of a severe scour hole downstream of the stilling basin. High flows during the spring of 1983 caused the structure to fail so another model investigation was necessary to develop a design for the replacement structure and to determine methods to stabilize the area downstream of the structure and the channel side slopes. Tests on a 1:25-scale hydraulic model of the replacement structure were conducted to develop the design. The model reproduced about 650 ft of topography upstream from the structure, the control structure, and 1,150 ft of topography downstream from the structure. Modifications to the original design were made to produce a structure that provided an acceptable headwater rating curve, and one with adequate energy dissipation in the stilling basin. A notched weir was developed that provided a desired range of headwater elevations for the expected discharges. The weir also produced velocities upstream and downstream from the low-flow notch for discharges less than 1,000 cfs that were considered appropriate for upstream fish migration. Stable riprap designs were determined for the channel bottom downstream from the stilling basin and the channel side slopes. (Author's abstract)
W87-07343

GRAVEL PACK THICKNESS FOR GROUNDWATER WELLS - REPORT NO. 1,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
C. P. Buyalski.
Available from the National Technical Information Service, Springfield, Virginia, 22161 as PB86-247368. Price codes:A05-PC in papercopy, A01-MF in microfiche. Bureau of Reclamation Report No. REC-ERC-86-7, June 1986. 70 p, 32 fig, 18 tab, 6 ref, append.

Descriptors: *Gravel packing, *Groundwater, *Wells, Well filters, Groundwater movement, Horizontal flow, Aquifers.

Gravel packs, well screens, and well development methods are being investigated for groundwater wells through an ongoing research and development program conducted by the Bureau of Reclamation Engineering and Research Center. A well sectional model study program was designed to determine the optimum gravel pack thickness by using the high-velocity horizontal water jetting well development method. The results indicate that the thickness of a gravel pack is limited to a practical dimension. The success of the prototype well operation depends on the effective destruction of the rigid wall cake (formed by the drilling operation) during the well development phase. A minimum thickness is recommended when employing the jetting method from inside the well. However, the gravel pack should be thick enough to provide an annular space that will ensure complete surrounding of the well screen by pack material during the placement operation. Therefore, the selection of the gravel pack thickness should be based on the efficiency of the well development method used and the ease of proper placement of pack material. (Author's abstract)
W87-07391

SPILLWAY DESIGN AFFECTS RESERVOIR WATER QUALITY,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
D. L. Rausch.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 462-466, 472, March-April 1986. 1 fig, 5 tab, 12 ref.

Descriptors: *Spillways, *Silting, *Reservoirs, *Water quality, Missouri, Sediments, Nutrients, Runoff, Ammonium, Orthophosphates, Density currents, Sediment control.

Reservoir water quality is affected by the type of spillway used in the structure. Research on three small reservoirs in central Missouri shows that not only does the bottom-withdrawal spillway im-

prove the quality of water stored, but it also prolongs the life of the structures. This is accomplished by discharging density currents as soon as they reach the deepest point in the reservoir while retaining the cleanest water on the surface. The data show that when compared with surface discharge, the bottom withdrawal discharged 1.7 to 3.2 times more sediment, 1.3 to 3.6 times more ortho-P and 1.8 to 5.9 times more ammonium. The deepest reservoir gave the highest number, indicating it received the most benefit from the bottom-withdrawal spillway. The average sediment trap efficiency of Bailey reservoir dropped from 88% for surface withdrawal to 74% for the bottom-withdrawal spillway. The larger runoff event still tends to give lower trap efficiency. (Author's abstract)
W87-07452

EVALUATION OF DROP-CHECK STRUCTURES FOR FARM IRRIGATION SYSTEMS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W87-07459

SLIPFORMED FACES PACE RAPID POURS FOR RCC DAM,
W. G. Reinhardt.
Engineering News - Record ENREAU, Vol. 217, No. 23, p 22-24, December 1986.

Descriptors: *Upper Stillwater Dam, Utah, *Dam construction, *Concrete dams, *Concrete construction, Construction, Dams, Concretes, Gravity dams, Concrete mixes, Hydraulic structures.

After an early winter shutdown, the contractor building the Upper Stillwater Dam in the Uinta Mountains of Utah now expects to place all of the final 638,000 cu yd before the winter of 1987. The Upper Stillwater is the world's largest roller-compacted concrete (RCC) dam and the first RCC dam built with slipformed facing elements. The contractor, Tyger Construction Co. Inc. of Spartanburg, SC, must slipform concrete facing elements this spring fast enough to keep pace with RCC placement as the 2,673-ft-long gravity dam grows thinner toward its 195-ft-high crest. So far, the method has worked well. The slipforms have been used to cast walls for the lower drainage gallery as well, and will be used also for the upper gallery. This innovation allowed RCC placement to continue uninterrupted during work on the lower gallery, saving nine days. Each slipform pass across the dam takes 9 to 12 hours. Previously, Tyger ran the machines across once every other day during the maintenance shift; next season, it will be necessary to make two passes a day. Three RCC mixes are used, all with a high fly ash content to retard set and increase workability. (Doria-PTT)
W87-07543

SIX DAMS TO DIVERT RIVER FLOWS,
B. Ryan.
Engineering News - Record ENREAU, Vol. 217, No. 24, p 28, December 1986.

Descriptors: *River flow, *Diversion dams, *South Africa, *Water resources development, *International agreements, *Lesotho, *Hydroelectric power, Flow, Diversion, Reservoirs, Electric power, Water supply, Water supply development, Powerplants, Hydroelectric plants, Tunnels, Dams, Rivers.

South Africa and Lesotho have signed a treaty to proceed with a $1.8 billion series of dams, hydroelectric plants, and tunnels to divert water into South Africa's industrial heartland and produce power. A binational body has been formed to oversee the project, which is currently entering its design phase. The project will divert water that would flow into the upper Orange River through six dams toward the upper Vaal River in South Africa. Four dams will be used for water storage, while the other two will create reservoirs for hydroelectric plants. Mashai Dam will be the largest (590 ft high and 2,591 ft long), impounding 3.5 million acre-ft of water. The project will be carried out in four stages, delivering water to the Vaal River by 1995 at the rate of 636 cu ft per second, and 2,285 cfs by 2017. Initial work will include construction of 150 miles of access roads in Lesotho and the upgrading of 170 miles of roads in the two nations. (Doria-PTT)
W87-07545

POSTCONSTRUCTION DEFORMATIONS OF ROCKFILL DAMS,
Hydro-Quebec, Montreal.
O. Dascal.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 113, No. 1, p 46-59, January 1987. 20 fig, 1 tab, 8 ref.

Descriptors: *Dam stability, *Rockfill dams, *Monitoring, *Deformation, *Safety, Prediction, Settlement, Deflection, Dams.

Postconstruction deformations of some rockfill dams with a slightly inclined or central till (moraine) core are presented. Although deformation may continue for 30 years after dam construction, settlement may nevertheless be considered to cease after 36 months. The crest settlement reflects the core compression, which is relatively low, while the downstream rockfill shoulders exhibit much higher settlements. The maximum settlement expressed as a percentage of height (%H) does not always concur with the maximum measured settlement value or with the maximum fill height. Depending on the valley cross section (width), an arching phenomenon can develop and push the maximum %H towards the abutments. Horizontal deflection downstream, also expressed as a percentage of the height of the dam crest, could reach 1.5-5.0 times the settlement value. The effect of impounding is illustrated by a differential deformation (settlement and deflection) of the upstream and downstream edge of the crest, inducing a progressive spreading (widening) of the crest (danger of longitudinal fissuration). Settlement and deflection envelope curves based on the values recorded by the analyzed structures could be used as a quick tool for monitoring the future behavior of dams and dikes. (Author's abstract)
W87-07578

PLUGGING INTO A DAM,
Illinois Univ. at Chicago Circle.
For primary bibliographic entry see Field 7C.
W87-07582

8B. Hydraulics

BREAKWATER GAP WAVE DIFFRACTION: AN EXPERIMENTAL AND NUMERICAL STUDY,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
J. D. Pos, and F. A. Kilner.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 113, No. 1, p 1-21, January 1987. 11 fig, 2 tab, 41 ref.

Descriptors: *Wave action, *Hydrodynamics, *Wavelengths, *Wave height, *Breakwaters, Finite element method, Waves, Shadow zone.

Breakwater gap configurations with gap-to-wavelength (B/L) ratios of 1.64, 1.20, 1.00, 0.75, and 0.50 were investigated, both experimentally (using close-range photogrammetry) and numerically (using finite and infinite elements). The experimental results, when compared to the finite element and available analytical results, show that: (1) the measured wave heights in the shadow zones (those regions sheltered by the breakwater arms) tend to be larger than predicted theoretically due to the combined effect of secondary waves generated at the breakwater tips and wave orthogonal spreading near the gap centerline (and subsequent wave orthogonal bunching in the shadow zones) caused by wave steepness differences along the crests; and (2) the wave heights outside the shadow zones tend to be smaller than predicted theoretically, again due to wave orthogonal spreading caused by the greater steepness of waves near the gap centerline. The results suggest that linear theory provides conservative wave height estimates outside the shadow zone, but underestimates wave heights in the shadow zone. (Author's abstract)
W87-06704

CHARACTERISTICS OF MECHANICALLY-GENERATED WAVES,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
Y. A. Papadimitrakis, E. Y. Hsu, and R. L. Street.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 113, No. 1, p 39-59, January 1987. 2 fig, 3 tab, 59 ref, 2 append. NSF Grant NSF-CEE-7817618 and ONR contract N00014-84-K-0242.

Descriptors: *Wave action, *Hydrodynamics, *Wave height, *Waves, *Wind waves, Wind effects, Dispersion, Amplitude.

The structure of a mechanically-generated sinusoidal, water-wave train of fixed frequency is examined under the influence of wind. The characteristics of this wave train were obtained with the aid of capacitance-type wave height gauges in a wind-wave research facility at Stanford University. Experimental results are given for seven wind speeds in the range 140-400 cm/s and 1 Hz, 2.54 cm (nominal) amplitude, mechanically-generated waves. The amplitude and phase of the various wave components were deduced by a simple method using their traveling wave property and their characteristic dependence upon the streamwise position in the channel. The dispersion relation and component phase speeds were also examined. It was found that: (1) the amplitude of the forced and free-traveling second harmonics compares favorably with existing theories; and (2) the nonlinearities of the primary wave, the interaction between short gravity waves and the primary wave, and the advection effects of wind drift are mainly responsible for the deviation of the measured phase speed from the linear theory. The latter results are consistent with the field measurements reported by other researchers, indicating that the apparent phase speeds at high frequencies are independent of the frequency. The measured phase speeds were also found to increase with wind speed, at a given frequency, in accord with previous laboratory measurements and theoretical computations. (Authors' abstract)
W87-06705

MEASUREMENTS OF LARGE STREAMWISE VORTICES IN AN OPEN-CHANNEL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2E.
W87-06822

TIDAL AND TIDALLY AVERAGED CIRCULATION CHARACTERISTICS OF SUISUN BAY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W87-06825

INCLINED DENSE JETS IN FLOWING CURRENT,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-06835

WAVE ACTION IN PUMPING STATION STORM OVERFLOW,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W87-06836

MCGEE CREEK PUMPING STATION SUMP PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
G. R. Triplett.
Available from the National Technical Information Service, Springfield, VA 22161as ADA 174884. Price codes: A03-PC in papercopy, A01-MF in microfiche. Technical Report HL-86-8, October 1986. Final Report. 35 p, 14 fig, 3 tab.

Descriptors: *McGee Creek, *Illinois, *Pumping plants, *Hydraulic models, *Hydrodynamics, *Model studies, *Hydraulic machinery, *Sumps, Channel flow, Flow profiles, Vortices.

The McGee Creek Pumping Station sump model study was conducted to evaluate the characteristics of inflow conditions and to develop modifications, if needed, to improve flow distribution to the pump intakes. The operation of the 1:10.4-scale model of the original design sump showed uniform flow distribution from the trapezoidal channel to the pump bays. Reasonably good flow distribution existed in the bay approach to the individual pumps. Eddies were generated as the flow came through the constricted sluice gate openings. Diverging sidewalls streamlined the flow back into the bay area, but there were no converging sidewalls for streamlining the flow into the constricted sluice gate opening due to the position and design of the sluice gate. Some dissipation of the eddies occurred in the bay approach area, while circular motion continued to the pump column area where surface vortices occurred under certain operating conditions. The intersump catwalk openings caused a problem when the water surface elevation was raised above el 421. Circular flow was generated as water flowed freely through these openings to adjacent sumps. This circular flow added to the problem from the eddies and gave strength to the formation of surface vortices. Test results indicated no significant increase in adverse flow due to off-center location of both side pumps in the original design. The original design intersump drain openings allowed some intersump flow, but its effect also was insignificant. This report does not advocate offcenter pump locations or intersump drain opening near the pump bell intake without a model study to determine their effect for a specific sump. These two irregular features (offcenter location of the pumps and intersump openings near the pump bell intake), combined with the eddy from the sluice gate openings, produced an overall adverse effect that was less than the adverse effects of some of the irregular features tested alone. The recommended design satisfactorily corrected the net adverse effects of these features. (Lantz-PTT)
W87-06999

SELECTIVE WITHDRAWAL RISER FOR CAVE RUN LAKE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. T. Maynord, and C. H. Tate.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-86-9, November 1986. Final Report. 75 p, 10 fig, 18 tab.

Descriptors: *Cave Run Lake, *Kentucky, *Selective withdrawal, *Hydrodynamics, *Reservoir operation, *Risers, Lakes, Performacne evaluation, Flow regulators.

Tests were conducted to determine the hydraulic and selective withdrawal characteristics of the proposed selective withdrawal riser for Cave Run Lake, Kentucky. A 1:18-scale model was used to investigate the hydraulic performance of the proposed add-on riser. Upper limits for satisfactory riser operation were found to depend on (a) submerged orifice flow, (b) adverse pressures, (c) turbulence within the riser, (d) pool or flow control oscillation, and (e) vortices. Pressures within the proposed riser were positive for all discharges up to 2,500 cfs, indicating that adverse pressure conditions will not have as significant an effect on riser discharge as will the other factors. Performance of the stilling basin for single gate operation was evaluated. Selective withdrawal studies were conducted in a 1:14.1-scale model. Various density profiles were used to study the withdrawal patterns of the proposed riser for different operating regimes. The top riser port nearest the embankment was found to have essentially the same selective characteristics as the other ports. (Author's abstract)
W87-07000

STUDY OF AERATION AT WEIRS AND CASCADES,
Maebashi City Coll. of Technology (Japan).
For primary bibliographic entry see Field 5G.
W87-07122

WEIR-ORIFICE UNITS FOR UNIFORM FLOW DISTRIBUTION,
Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Civil Engineering.
A. S. Ramamurthy, U. S. Tim, and M. V. J. Rao.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 155-166, February 1987. 6 fig, 1 tab, 9 ref.

Descriptors: *Open-channel flow, *Wastewater treatment, *Orifices, *Weirs, *Model studies, Mathematical analysis, Froude number, Hydraulics, Wastewater facilities, Design criteria.

Very limited information is available to the engineer for the analysis of open channel distribution devices consisting of a lateral weir and an orifice that can be used effectively in the design of both water and wastewater treatment plants. A method to analyze the flow through such partitioned weirs in a distribution channel is presented. For purposes of analysis, a single unit of weir-orifice combination is considered. Flow through rectangular lateral weir-orifices is obtained using an existing hydrodynamic model for the lateral efflux from a two-dimensional channel. The design procedure for proportioning the weir orifice unit for a given inflow is discussed. It is shown that weir-orifice units can be properly designed to ensure an outflow that is a prescribed percentage of the channel inflow over a range of upstream flow depths. The experimental data obtained in a test flume provide a verification of the theoretical relationship between the geometric and hydrodynamic parameters of the weir-orifice flow. The predicted relationships are valid for flow through a lateral weir-orifice unit that can be as wide as the main channel. (Airone-PTT)
W87-07128

LITTLE SIOUX CONTROL STRUCTURE, LITTLE SIOUX RIVER, IOWA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W87-07343

TRANSVERSE MIXING IN MEANDERING LABORATORY CHANNELS WITH RECTANGULAR AND NATURALLY VARYING CROSS SECTIONS,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 2E.
W87-07420

APPLICATION OF PARAMETRIC MIXED-INTEGER LINEAR PROGRAMMING TO HYDROPOWER DEVELOPMENT,
Hydro-Quebec, Varennes.
For primary bibliographic entry see Field 7C.
W87-07471

SOME SPACE-FILLING CONTROLS ON THE ARRANGEMENT OF TRIBUTARIES IN DENDRITIC CHANNEL NETWORKS,
State Univ. of New York at Buffalo. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W87-07478

SOME DYNAMIC ASPECTS OF RIVER GEOMETRY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W87-07480

HYDRAULICS OF PARTIALLY FILLED EGG SEWERS,
Detroit Water and Sewerage Dept., MI.
M. A. Gill.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 113, No. 2, p 407-425, April 1987. 5 fig, 4 tab, 7 ref, 2 append.

Descriptors: *Hydraulics, *Hydrodynamics, *Egg sewers, Flow, Geometry, Sewers.

Geometric characteristics are computed for different values of dimensionless depth y/H for the ovoidal, ovoid, standard, and sharp egg sewers and are presented in tables. The solution of a large variety of hydraulic problems in these egg sewers is facilitated using these tables. Approximate solutions are also presented, mainly for the computation of the gradually varied flow in the ovoidal, ovoid, and standard egg sewers; the ranges of applicability of the approximate solutions are indicated. Approximate solutions are quick and sufficiently accurate for practical purposes. (Author's abstract)
W87-07503

DIFFRACTION BY A GAP BETWEEN TWO BREAKWATERS: SOLUTION FOR LONG WAVES BY MATCHED ASYMPTOTIC EXPANSIONS,
Hydraulics Research Station, Wallingford (England).
J. V. Smallman.
Journal of Fluid Mechanics JFLSA7, Vol. 172, p 143-155, November 1986. 5 fig, 3 tab, 9 ref.

Descriptors: *Hydrodynamics, *Breakwaters, *Diffraction, *Mathematical models, *Waves, *Fluid mechanics, *Boundary conditions, *Model studies, *Hydraulics, Mathematical studies, Mathematical analysis, Mathematical equations.

A mathematical model is constructed to represent the diffraction of plane harmonic waves through a gap between two semi-infinite breakwaters in water of constant depth. The boundary-value problem corresponding to this model is formulated and then specialized to the case of waves that are long relative to the gap width. A solution to the long-wave problem is found using the method of matched asymptotic expansions. In particular, an expression has been found for the far-field diffraction coefficient in the lee of the breakwaters. This coefficient may be used to find the diffracted wave-height ratio at distances far from the breakwater tip and also constitutes the initial data to solve the corresponding diffraction/refraction problem. The far-field diffraction coefficient is used to demonstrate trends in the behavior of the diffracted field for a number of different breakwater configurations. (Author's abstract)
W87-07549

8C. Hydraulic Machinery

MITIGATING COPPER PITTING THROUGH WATER TREATMENT,
Copper Development Association, Inc., Greenwich, CT.
For primary bibliographic entry see Field 5F.
W87-06776

INFLUENCE OF BUFFER CAPACITY, CHLORINE RESIDUAL, AND FLOW RATE ON CORROSION OF MILD STEEL AND COPPER,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5F.
W87-06777

Group 8C—Hydraulic Machinery

EFFECTS OF SHORT-TERM CHANGES IN WATER QUALITY ON COPPER AND ZINC CORROSION RATES,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W87-06779

WAVE ACTION IN PUMPING STATION STORM OVERFLOW,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. Ellis, and W. Mualla.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 342-352, March 1987. 7 fig, 3 tab, 2 ref.

Descriptors: *Outfall, *Wastewater disposal, *Outfall sewers, *Model studies, *Waves, *Hydraulic machinery, *Hydrodynamics, *Tidal flap doors, *Storm overflow, *Pumping plants, Simulation, Oscillatory flow, Flow, Numerical analysis.

A method of analysis of tidal flap doors under oscillatory flow conditions is presented. Hydrodynamic data for flap doors is given for use in numerical simulation of door movement. Application of the data is illustrated by considering the case of a pumping station overflow that includes twin tidal flap doors. Boundary conditions for the numerical model are the inflow to the pumping station and the time history of pressure at the outfall determined from wave-climate measurements offshore. Computations were undertaken with a threefold purpose: to establish peak water levels in the pumping station for selection of safe machinery levels; to determine the closure rate of flap doors to assess risk of slamming; and to quantify airflow rates to and from access chambers to provide adequate venting arrangements. (Author's abstract)
W87-06836

MANUAL FOR HIGHWAY STORM WATER PUMPING STATIONS: VOLUME 2,
Lever (William F.) and Associates, Long Beach, CA.
W. F. Lever.
Available from the National Technical Information Service, Springfield, Virginia, 22161, as PB84-152735. Price codes: A10-PC in paper copy, AO1-MF in microfiche. Federal Highway Administration Report No. FHWA-IP-82-17-v2. Dot-FH-11-9282.

Descriptors: *Pumping plants, *Highway, *Storm water, *Design standards, Construction methods, Hydraulic machinery, Economic aspects.

This manual provides a comprehensive source of design information on storm water pumping stations for highway facilities. However, users are cautioned to use proper engineering judgment and must themselves be entirely responsible for any interpretation and applications of the data and opinions set forth herein. An initial field survey was conducted to determine the present practices and experiences in several States, which proved to be extremely varied, with some basic differences in design concepts. All states were invited to submit information on their installations and most did so. Some of the data presented have been taken from these submittals, and some from relevant literature. Some have been drawn from manufacturers' catalogs. Examples from actual pumping stations have been incorporated whenever possible, by reproducing photographs or construction drawings in simplified form. Various types of pumping stations are discussed in the early chapters, with guidance as to which might be expected to be most suitable for various conditions. Later chapters deal with station machinery and features, including electrical systems. A number of appendices cover specifications, construction costs, energy economics, and maintenance. (Author's abstract)
W87-06942

MCGEE CREEK PUMPING STATION SUMP PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W87-06999

SELECTIVE WITHDRAWAL RISER FOR CAVE RUN LAKE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W87-07000

APPROPRIATE TECHNOLOGY FOR PLANNING HYDROELECTRIC POWER PROJECTS IN NEPAL: THE NEED FOR ASSUMPTION ANALYSIS,
Texas Univ. at Austin. Dept. of Civil Engineering.
C. G. Chandler.
Technical Report CRWR-182, June 1981. 220 p, 19 fig, 23 tab, 71 ref.

Descriptors: *Hydroelectric power, *Nepal, *Management planning, *Project planning, *Assumption analysis, Electric power production, Hydrologic properties, Geology, Environmental effects, Social impact.

The study focuses on the project development process for hydroelectric project planning in Nepal. Chapter I describes the contrast between the vast potential for hydroelectric power development in Nepal and the current energy shortage within the country, not only for electricity, but for firewood and other fuel sources as well. Chapter II explores some of the unknown factors facing hydropower project planners in Nepal, where data for hydrologic, geologic, environmental, and sociological project components are lacking. The chapter also examines institutional and fiscal factors which constrain the planning process. Chapter III describes the critical role of assumptions in the project development process, and details the stages that a project goes through as it is planned. The chapter introduces the concept of assumption analysis as a technique for project planning, listing the potential conflict between the assumptions of foreign consultants and the host-country users of project outputs as an ingredients in the project's success or failure. Chapter IV demonstrates the mechanics and usefulness of assumption analysis through an Assumption Analysis Chart, which shows the interaction among project objectives, project alternatives, project assumption, and the project development process. Assumption analysis techniques are expected to be useful among bilateral and multilateral aid donors servicing less developed countries. (Author's abstract)
W87-07030

8D. Soil Mechanics

INFLUENCE OF HAZARDOUS AND TOXIC WASTES ON THE ENGINEERING BEHAVIOR OF SOILS,
Woodward-Clyde Consultants.
For primary bibliographic entry see Field 5C.
W87-07264

POSTCONSTRUCTION DEFORMATIONS OF ROCKFILL DAMS,
Hydro-Quebec, Montreal.
For primary bibliographic entry see Field 8A.
W87-07578

EFFECTS OF SEASON AND MANAGEMENT ON THE VANE SHEAR STRENGTH OF A CLAY TOPSOIL,
Agricultural Research Council, Wantage (England). Letcombe Lab.
J. T. Douglas.
Journal of Soil Science JSSCAH, Vol. 37, No. 4, p 669-679, December 1986. 4 fig, 5 tab, 20 ref.

Descriptors: *Vane shear strength, *Seasonal variation, *Strength, *Topsoil, *Clays, *Soil management, Soil types, Soil properties, Soil water, Soil density, Soil structure, Soil organic matter, Density, Cultivation, Grasslands, Drying, Organic matter, Aggregates, Roots, Freezing, Shear.

Vane shear strength, water status, and bulk density were measured at various times in a growing season at two depths in a swelling clay topsoil. The site comprised experimental plots that had been plowed annually or direct-drilled for 10 years; short-term fallow areas, created on adjacent long-term grassland, were compared with the arable plots. In the middle of the topsoil layer (nominally 120 mm depth) of all three treatments, shear strength was linearly related to water content, and similarly to bulk density in the direct-drilled and plowed soils. Closer to the soil surface (nominally 40 mm), relationships between strength and wetness or density were less distinct, particularly in the spring, when drying was not accompanied by an increase in strength; possible reasons for this anomaly are considered. The shear strength of the untilled soils was greater, at both depths, than that of the plowed soil. Other factors, including density, water potential, soil structure, and organic constituents, differed with time or between treatments, and their contribution to variations in shear strength are discussed. (Author's abstract)
W87-07580

8E. Rock Mechanics and Geology

TUNNELS: MACHINE EXCAVATION-RATE OF PROGRESS-MACHINE DATA,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8H.
W87-07345

8F. Concrete

STRENGTH DESIGN OF REINFORCED CONCRETE HYDRAULIC STRUCTURES, REPORT 4: LOAD-MOMENT CHARACTERISTICS OF REINFORCED CONCRETE CIRCULAR CONDUITS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
V. P. Chiarito, and P. F. Mlakar.
Available from the National Technical Information Service, Springfield, VA 22161As ADA 173229. A08 in papercopy, A01-MF in microfiche. Technical Report SL-80-4, August 1986. Report 4 of a Series. 170 p, 48 fig, 8 tab, 24 ref, 5 append.

Descriptors: *Reinforced concrete, *Hydraulic structures, *Concrete, *Conduits, *Load distribution, Concrete technology, Concretes, Concrete construction.

The effect of initial curvature on the thrust-moment characteristics of reinforced concrete circular conduit sections was investigated. This study was undertaken since conduit sections built by the Corps of Engineers are often so sharply curved relative to their thicknesses that initial curvature effects might be significant. The effect of initial curvature was investigated through curved beam, airy stress function, and nonlinear finite element analyses. In addition, three model conduits representative of Corps construction were instrumented and simultaneously loaded on eight equally spaced diameters. For the range of design variables investigated, the analytical and experimental results indicate that initial curvature has no statistically significant effect. Further testing will be needed to obtain a larger statistical sample and evaluate the effects of more extreme curvatures than studied. (Author's abstract)
W87-07018

WASTEPAPER FIBERS IN CEMENTITIOUS COMPOSITES,
Steinbrugge, Thomas and Bloom, Inc., Newport Beach, CA.
C. O. Thomas, R. C. Thomas, and K. C. Hover.
Journal of Environmental Engineering JOEDDU (ASCE), Vol. 113, No. 1, p 16-31, February 1987. 11 fig, 1 tab, 20 ref.

Descriptors: *Cements, *Concrete additives, *Concrete technology, *Construction materials, *Pulp and paper industry, *Recycling, Pulp wastes, Durability, Strength, Sludge drying, Sludge utilization, Plant fibers.

The use of cellulose fibers, reclaimed from wastewater from paper recycling, as reinforcement in cementitious building products is discussed. An experimental program investigates the development of a material composed of Portland cement mixed with sludge produced by wastewater treatment from a paper recycling plant. This sludge consists primarily of cellulose fibers and Kaolinitic clay. The primary obstacle in the development of a mixing process is the problem of achieving an intimate mixing of the fibers and the cement, as the fibers tend to coalesce and form soft inclusions in the hardened mass. This problem is overcome by introducing the cement into the sludge prior to chemical or mechanical dewatering, followed by vibratory and pressure dewatering of the cement/sludge slurry. Optical and electron microscope photographs clearly indicate the differences between mixing techniques. Physical properties of the resulting mass are measured as a function of varying mix proportions and mixing techniques. Compressive strength on the order of 10.3 MPa (1500 psi), and tensile strength on the order of 2.8 Mpa (400 psi) were obtained. Thus, potentially useful construction materials such as building blocks, shingles, wallboards, fire retardants, and insulation may be produced by the process here described. The durability and dimensional stability of the composite material remain to be evaluated. (Airone-PTT)
W87-07120

EVALUATION OF DROP-CHECK STRUCTURES FOR FARM IRRIGATION SYSTEMS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W87-07459

SLUDGE ASH AS FILLER FOR PORTLAND CEMENT CONCRETE,
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
For primary bibliographic entry see Field 5E.
W87-07498

SLIPFORMED FACES PACE RAPID POURS FOR RCC DAM,
For primary bibliographic entry see Field 8A.
W87-07543

8G. Materials

CORROSION MONITORING AND CONTROL IN THE PACIFIC NORTHWEST,
Washington Univ., Seattle.
For primary bibliographic entry see Field 5F.
W87-06778

ULTRAVIOLET DEGRADATION OF CORRUGATED PLASTIC TUBING,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. D. Desmond, and G. O. Schwab.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 2, p 467-472, March-April 1986. 6 fig, 4 tab, 25 ref.

Descriptors: *Plastic tubing, *Ultraviolet radiation, *Pipes, *Degradation, *Embrittlement, Ohio, Solar radiation, Impact test, Shelf life, Construction materials.

The embrittlement rates of corrugated plastic tubing (CPT) resulting from two accelerated ultraviolet (UV) exposure methods were compared with that of natural sunlight exposure in Ohio. CPT storage shelf life predictions were based on the effect of UV light exposure. Fourteen average months of Ohio exposure, or 5600 MJ/sq m of solar energy, is the maximum recommended shelf life for storage of CPT. Shelf life tests can be made by accelerated exposure of 450 MJ/sq m of concentrated sunlight or by 800 Weatherometer hours of exposure both followed by a flat plate impact of 30 J. Protection from UV embrittlement during the recommended shelf life is adequate if all samples exposed on accelerated machines pass the impact test. (Author's abstract)
W87-07453

8H. Rapid Excavation

TUNNELS: MACHINE EXCAVATION-RATE OF PROGRESS-MACHINE DATA,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. S. Sinha.
Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 as PB86-239860. Price codes: A03-PC in papercopy, A01-MF in microfiche. Bureau of Reclamation Report No. REC-ERC-86-8, July 1986. 37 p.

Descriptors: *Machine excavation, *Tunnel construction, *Tunneling, *Machine data, *Rapid excavation, Hydraulic machinery, Rocks, Rock properties, Compressive strength, Boring.

Information on 20 machine-bored water tunnels constructed by the Bureau of Reclamation is presented graphically and pictorially. Machine data, rates of progress, tunnel profiles, and rock types and strengths are given for each tunnel. The bored diameters of these tunnels varied from 9 to 21 feet. Rocks encountered in boring were: shale, sandstone, conglometerate, quartzite, limestone, siltstone, granite porphyryr, granite gneiss, gneissic granodiorite, rhyolite, rhyodacite, and agglomerate. The compressive strengths of these rocks were 300 to 38,000 psi. The boring rates of the machines used varied from 17 to 107 feet for the average calendar day. The maximum progress was 403 feet in 1 three-shift day. This rate was attained in 17.3 hours of machine time while boring an 8-foot 7-inch diameter tunnel through shale having a maximum compressive strength of 6,000 psi. Contract and miscellaneous data are also given for each of the tunnels. (Author's abstract)
W87-07345

8I. Fisheries Engineering

MICROBIOLOGICAL ASPECTS OF FISH GROWN IN TREATED WASTEWATER,
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5C.
W87-06748

IMPACT OF PADDLEFISH ON PLANKTON AND WATER QUALITY OF CATFISH PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
J. S. Burke, and D. R. Bayne.
The Progressive Fish-Culturist PFCUAY, Vol. 48, No. 3, p 177-183, July 1986. 3 fig, 1 tab, 25 ref.

Descriptors: *Paddlefish, *Limnology, *Fish ponds, *Water quality, *Catfish ponds, *Catfish, Fish, *Zooplankton, Aquatic life, Chlorophyll a, Ammonia, Nutrients, Grazing, Food habits, Nitrogen, Nitrites, Ponds, Plankton, Seasonal variation, Algae.

The effects of paddlefish (Polyodon spathula) on zooplankton, chlorophyll-a, total ammonia nitrogen, and nitrite in a yearling paddlefish-catfish polyculture were measured in eight 0.04-hectare ponds. All ponds were stocked with channel catfish (Ictalurus punctatus) and the hybrid, channel catfish x blue catfish (Ictalurus furcatus), at commercial stocking rates and four ponds were stocked with paddlefish at a rate of 990/hectare. In the paddlefish treatment, zooplankton densities were significantly lower, particularly during the period March through May. Some recovery of the zooplankton occurred June to September. Seasonal mean chlorophyll-a concentrations were significantly higher in the paddlefish treatment, apparently because of reduced zooplankton grazing pressure. Dissolved nitrogen was related inversely to chlorophyll-a concentrations. The unchecked growth of the algal community (particularly of colonial forms) in the paddlefish treatment apparently interfered with efficient feeding of paddlefish on available zooplankton. (Author's abstract)
W87-06780

APPLICATION OF A STRATEGY TO REDUCE ENTRAINMENT MORTALITY,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5C.
W87-06786

PEN REARING AND IMPRINTING OF FALL CHINOOK SALMON,
Seattle National Fishery Research Center, WA.
J. F. Novotny, T. L. Macy, and J. T. Gardenier.
Available from the National Technical Information Service, Springfield, VA 22161, as DE84013592. Price codes: A04 in paper copy, A01 in microfiche. Annual Report, 1983. DOE Report DOE/BP--241, February 1984. 50 p, 1 fig, 5 tab, 4 ref, 3 append.

Descriptors: *Salmon, *Fisheries, *Fish handling facilities, *Columbia River, *Spawning, *Fish management, *Washington, Fish populations, Hydroelectric plants, Ecological effects.

Historical anadromous fish populations have been severely impacted by the construction and operation of hydroelectric dams on the Columbia River. Previously used spawning and nursery habitat has either been eliminated, inundated, or rendered useless by main stem dams and reservoirs. These losses have been partly compensated for by increased hatchery production, especially in the Columbia River stretch below the Dalles Dam. For example, compensation for lost spawning habitat of fall chinook salmon caused by the John Day Project has been the release of fish reared at Bonneville Hatchery and at Spring Creek National Fish Hatchery. The adults, however, return to the hatcheries from where they are released and do not enter the fishery above the respective points of origin. Therefore, it has become necessary to develop a methodology for moving the production of the anadromous fishery back into the upper reaches of the Columbia River Basin. The goal of the present project is to determine the feasibility of rearing and acclimating age-0 fall (upriver bright) chinook salmon in 'off-station' facilities (an acclimation pond and a backwater) located above John Day Dam. Should the methodology prove feasible in returning adults into the John Day reach, it could be applied throughout the Columbia River Basin. Returning adults will be available for harvest by the Zone VI Indian fishery, for brood stock in subsequent off-station rearing projects, and for outplanting in nearby rivers and streams. (Lantz-PTT)
W87-07014

BRINGING UP OYSTERS,
For primary bibliographic entry see Field 2H.
W87-07134

CONTROL OF XENOPUS LAEVIS (AMPHIBIA: PIPIDAE) IN FISH PONDS WITH OBSERVATIONS ON ITS THREAT TO FISH FRY AND FINGERLINGS,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
M. Schramm.
Water S. A. WASADV, Vol. 13, No. 1, p 53-56, January 1987. 1 fig, 2 tab, 20 ref.

Descriptors: *Frogs, *Carp, *Fish hatcheries, Food chains, Phytoplankton, Aquaculture, Predation, South AFrica.

Predation by African clawed frogs Xenopus larvis threatened fry and fingerlings of common carp Cyprinus carpio and Chinese silver carp Hypophthalamichthys molitrix in nursery ponds in

Transkei, Southern Africa. Competition for food (phytoplankton) between Xenopus tadpoles and silver carp appeared to affect the growth of the fish. However, the potential competition between Xenopus adults and common carp for benthic prey was not realized. Although solid barriers around pools are the most efficient means of preventing recolonization of frog-free ponds, the traps used were a viable, inexpensive means of control. The use of largemouth bass as a predator for controlling Xenopus tadpoles is not recommended for nursery ponds. (Author's abstract)
W87-07156

APPLICATION OF FISHERIES MANAGEMENT TECHNIQUES TO ASSESSING IMPACTS,
Battelle Pacific Northwest Labs., Richland, WA.
D. H. McKenzie, M. A. Simmons, and J. R. Skalski.
Available from the NRC Public Document Room, 1717 H Street, N.W., Washington, DC. NUREG/CR-2804, PNL-4313, January 1983. 48 p, 2 fig, 10 tab, 19 ref, 2 append.

Descriptors: *Fisheries management, *Water pollution effects, *Monitoring, Bioindicators, Population dynamics, Population exposure, Statistical analysis, Sampling, Ecological effects.

Monitoring methods used in fisheries management assessments were examined and their potential applicability in confirmatory impact monitoring were evaluated using case studies from selected nuclear power plants. A report on Task I of the project examined the application of Catch-per-Unit-Effort (CPUE) techniques in monitoring programs at riverine, large lake and ocean sites. Task I results are for three categories of techniques; catch removal, population dynamics and nondestructive censuses. Population dynamics approaches were not pursued in spite of their initial attractiveness because of disadvantages in data requirements, statistical methodology, and interpretability of results. Two methods were recommended for further development; CPUE and Hydroacoustical techniques. Examination of Oconee, a reservoir site, and included in this report, completes Task II efforts. The results of these efforts indicated that field experience does not support the assumptions underlying the CPUE approach. The assumption that CPUE indices can quantify reasonable population changes, at least within levels of sampling effort historically expended, does not appear to be supported by monitoring data. The 'signal to noise ratio' and large CV values encountered in monitoring data indicated that relatively large changes may go undetected. CPUE evidence on population status was found to be dependent on season and time of sample collection. Generally, multiple sampling stations and years presented conflicting pictures of population status. Thus, the interpretation of CPUE monitoring data must depend upon the experienced judgement of ecologists until better sampling and statistical methods can be developed that will quantify changes in catchability and variability among years. (Lantz-PTT)
W87-07339

9. MANPOWER, GRANTS AND FACILITIES

9B. Education (In-House)

WATER TREATMENT PLANT OPERATION VOLUME I: A FIELD STUDY TRAINING PROGRAM.
California State Univ., Sacramento. School of Engineering.
For primary bibliographic entry see Field 5F.
W87-07035

HEALTH AND SAFETY CONSIDERATIONS FOR HAZARDOUS WASTE WORKERS,
Brigham Young Univ., Provo, UT.
L. P. Wallace, and W. F. Martin.
IN: Management of Toxic and Hazardous Wastes, Lewis Publishers, Inc., Chelsea, Michigan. 1985. p 25-34, 9 ref.

Descriptors: *Training, *Personnel, *Waste disposal, *Hazardous wastes, Education, Safety, Protection, Decontamination, Cleanup operations.

Workers can work safely at a hazardous waste site if they are informed of the hazard involved, receive the necessary training, follow the proper procedures and/or instructions, use the required personal protective equipment, and remain aware of the conditions or situations around them at all times. The following ten considerations summarize elements of a sample health and safety program for hazardous waste workers. (1) A proper identification and quantification of the materials to be handled. (2) A constant surveillance of the work environment (for example, a knowledge of weather conditions, contaminant levels, and fire/explosion potential). (3) The necessary protective equipment available and properly maintained (that is, both the personal protective equipment and the engineering equipment to provide protection for and/or isolation of the hazard). (4) An appropriate medical surveillance program, including a record of preemployment conditions and work-related exposures. (5) A comprehensive program for continual training of workers in all aspects of health and safety commensurate with their work responsibilities. (6) A proper decontamination program (that is, a method or preventing unnecessary worker exposure and eliminating migration of contaminants from the site). (7) A comprehensive site work plan including a fire and spill emergency control plan. (8) A communication/safety program which keeps track of everyone on-site and provides for medical, emergency, and/or community contacts. (9) A site security plan for properly designating and controlling access to and exit from contaminated, decontaminated and safe areas. (10) A proper logistics plan (that is, appropriate arrangements for eating, sleeping, washing and drinking water, compressed air, etc). (See also W87-07243) (Lantz-PTT)
W87-07247

EVOLUTION IN COMPUTER PROGRAMS CAUSES EVOLUTION IN TRAINING NEEDS: THE HYDROLOGIC ENGINEERING CENTER EXPERIENCES,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2A.
W87-07303

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10C. Secondary Publication And Distribution

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National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
J. W. Lavelle, and H. O. Mofjeld.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 3, p 389-393, March 1987. 80 ref.

Descriptors: *Erosion, *Channel erosion, *Turbulent flow, *Sediments, *Critical stress, *Sediment transport, *Literature reviews, *Bibliographies.

In 1966, the Task Force Committee on Preparation of the Sedimentation Manual prepared a bibliography on initiation of sediment motion as part of their discussion of that concept. Since that time many additional experiments have been conducted that bear on the conditions of first motion. Because so many important papers have been added to the literature since the 1966 review, a bibliography centered on subsequent work on thresholds was assembled, although the most important earlier work is also included. The focus is on abiotic, noncohesive sediments; however, a few papers on cohesive sediments are also included that bear on the threshold issue as are important publications related to turbulence phenomena in boundary layers. (See also W87-06838) (Peters-PTT)
W87-06839

ANNOTATED BIBLIOGRAPHY FOR NAVIGATION TRAINING STRUCTURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W87-07027

10F. Preparation Of Reviews

NOTATION FOR USE IN THE DESCRIPTION OF WASTEWATER TREATMENT PROCESSES,
For primary bibliographic entry see Field 5D.
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